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DETERMINANTS OF PRETERM DELIVERY IN RIDGE REGIONAL HOSPITAL, GREATER ACCRA

BY

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DECLARATION

I, ERNEST KONADU ASIEDU hereby declare that with the exception of the references made to other peoples' work which I have duly acknowledged, this proposal which is my original work has neither in whole nor in part been presented to the University or elsewhere for another degree.

Signature ……..

Date ……..

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Signature ……

Date ……

Prof. Col. Edwin A. Afari (Rtd)

(Supervisor)

DEDICATION

I dedicate this dissertation to God Almighty, my parents, Mr. and Mrs. Asiedu; my siblings, Albert, Edward, Evans, Gifty, Rita and Richard; my wife Levlyn and my children Beveridge, Kirsten and Eldridge. They have all been a source of constant inspiration

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ABSTRACT

Introduction: Globally, prematurity is a major determinant of neonatal morbidity and mortality contributing about 30%-40% of neonatal mortality and 20% to 30% of infant and under-five mortality. The world's preterm birth rate keeps rising since the last two decades with an increase of 20% since 1990 in high-income countries. Major risk factors remain unknown. The consequences are enormous with developmental and childhood complications as well as high economic and psycho-social burden on the parents (family) and society. The objectives of the study assessed determinants (maternal and foetal factors) of preterm delivery.

Methods: The study was conducted in Ridge Regional Hospital, a secondary referral facility in Accra, Ghana (October, 2015 -May, 2016). Firstly, the proportion of preterm delivery was determined by reviewing the summary data of preterm delivery and total delivery from the health information unit of the hospital. Secondly, 1:2 unmatched case-control study design was adopted. The sample size of 360 mother and baby pairs were selected with 120 cases and 240 controls. A case was a mother who delivered between 28 weeks and 36 weeks of gestation (preterm) and a control was a mother who delivered after 37 completed weeks (term). Data collection was done by interview technique using structured questionnaire and review of maternal and foetal records using a checklist. Univariable analysis of categorical variables was expressed as frequencies, proportions and Chi-square analysis to establish associations between selected individual independent variables and preterm delivery. Multiple logistic regression was done between independent variables and preterm delivery to determine the strength of association with Odds Ratio 95% CI and their respective significance.

Results: In all, 130 preterm deliveries and 260 term deliveries were studied. Proportion of preterm delivery was 15.3% .Odds Ratios for Partner support was 0.4 (95%CI 0.2-0.9), ANC visit ≥ 4 times was 0.2(0.02-0.05), Male baby was 0.5(0.3-0.9), Cephalic presentation was 0.5(0.3-0.9), and Apgar score of >7 was 0.3(0.2-0.5). These variables protected against preterm delivery.ry. However, Odds Ratios for hypertensive complications was, antepartum haemorrhage was 2.1(1.1-4.5), premature rupture of membrane was 1.7(1.1-2.6) and Caesarean section delivery was 1.4(1.2-4.6). These variables were determinants of preterm delivery.

Conclusion: Proportion of preterm delivery is high. Partner support is protective. However, preterm premature rupture of membrane, hypertensive complications and antepartum haemorrhage are likely contributing determinants of preterm delivery. Birth weight ≥2.5 and Apgar score >7 are protective. Partner support policy implementation may reduce preterm delivery.

Keywords: Determinants, Partner support, Policy Preterm Delivery, Unmatched Case-Control

LIST OF ABBREVIATIONS

AM	-	Accra Metropolis
ANC	-	Antenatal care
AVD	-	Assisted Vaginal Delivery
a OR	-	Adjusted Odds Ratio
BMI	-	Body Mass Index
CI	-	Confidence Interval
c OR	-	Crude Odds Ratio
CS	-	Caesarean Section
DHS	-	Demographic and Health Survey
EmONC	-	Emergency Obstetric and Neonatal Care
FHD	-	Family Health Division
GAR	-	Greater Accra Region
GHS	-	Ghana health Service
ITNs	-	Insecticide Treatment Nets
NICU	-	Neonatal Intensive Care Unit
KMC	-	Kangaroo Mother Care
LUSCS	-	Lower Uterine Segment Caesarean Section
NVD	-	Normal Vaginal Delivery
OR	-	Odds Ratio
PN	-	Post-Natal
PPROM	-	Preterm Premature Rapture of Membrane
PTB	-	Preterm Birth / Preterm delivery
RHD	-	Regional Health Directorate
RRH	-	Ridge Regional Hospital
SVD	-	Spontaneous Vertex Delivery
WHO	-	World Health organisation

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DEFINITION OF TERMS

Preterm, according to the World Health Organisation (WHO), refers to babies born alive before 37 completed weeks of gestation. It can be classified into three groups:

1. Extremely preterm (<28 weeks),
2. Very preterm (28 to <32 weeks) and
3. Moderate to late preterm (32 to <37 weeks).

Term refers to babies born at 37 completed weeks(Blencowe et al., 2013) .

Preterm or premature baby is one that is born after 28 weeks but before 37 completed weeks of gestation.

Hyperglycemia is blood glucose level of >7mmol/L when fasting and/or >11 mmol/L if post-prandial

Tocolytic is the medication given to stop premature contraction

CHAPTER ONE

1.0 INTRODUCTION

1.1 Background to the study

If a baby is born early - also called 'premature' or 'preterm' – he/she may need special care. Also referred to us premature birth, preterm birth is the number one cause of death during the first month of life contributing about 30% - 40%, second only to infection and contributing 20%-30% infant and under-five mortality (Liu et al., 2015). Babies who make it often face a lifetime of medical setbacks (Blencowe et al., 2013; Global Moms Challenge, 2012)

For the purpose of this research, the definition of a 'premature' or 'preterm' baby is one that is born after 28 weeks but before 37completed weeks of gestation. Operationally, the focus of this research will be categorized into very preterm and moderate to late preterm (based on the WHO definition) as viability start from 28 weeks in Ghana.

Premature birth (before 37 completed weeks of pregnancy) is the most common cause of neonatal death.

Millennium Development Goal 4 focused on reducing under-five mortality of which neonatal mortality contributes significantly. The 2015 target of less than 40 per 1000 live births that was set using the 1990 rate of 110-120 per 1000 live births could not be accomplished (Ghana Data,2014). Preterm birth is a major cause of neonatal death and a significant cause of long-term loss of human potential amongst survivors. Complications of preterm birth are the single largest direct cause of neonatal deaths, responsible for 35%

of the world's 3.1 million deaths a year, and the second most common cause of under-5 deaths after pneumonia. (Blencowe et al., 2013)

Internationally, preterm birth is a major public health concern causing over 1 million deaths annually and high rates of morbidity and disability among survivors (Chang et al., 2013). Consequently, prevention of preterm birth has been a major focus of interest.

There are many different causes of neonatal mortality globally, regionally and in Ghana. Globally, the main causes of neonatal deaths are preterm birth complications (35 percent), intrapartum-related complications (including complications during labour and delivery such as with asphyxia) (24 percent), and sepsis including neonatal tetanus and pneumonia (15 percent). (WHO 2014) Together, these three major categories account for almost three-quarters of all neonatal deaths. The others are in the minority accounting for about 26 percent which include congenital malformations or anomalies and hereditary disorders (Liu et al., 2015).

Almost 30 percent of babies born at 23 weeks of gestation survive, while about 50% to 60% of babies born at 24 weeks with about 75% born at 25 weeks, and more than 90 percent born at 27 weeks to 28 weeks, survive.

Based on the above, it is obvious that there is no single aetiological factor that causes premature delivery. However, the later a baby is born, the more likely he/she is to survive among other factors. For this reason, it may be difficult to tell whether a pregnancy apart from normal symptoms of being pregnant, like backache will end up preterm and so it is always advisable to get warning signs checked out.

Data on preterm birth rates are not routinely collected in many countries and, where available, are frequently not reported according to the WHO standard definition of preterm delivery. Time series using consistent definitions are lacking for all but a few countries, making comparison within and between countries challenging.

Globally, about 15 million babies were born too soon indicating that, 1 out of every 10 babies are born prematurely. According to estimates by the World Health Organization (2014), among the 130 million infants born each year worldwide, 8 million die before reaching their first birthday(WHO, 2014).

Although some information is being collected, accurate data from low-income and low-middle income countries including Ghana are not readily available in the national database system. In 2006, preterm births constituted 12.8% of live births in the United States, (Martin et al., 2009).

In the 20th century, preterm birth was seen as an unpredictable and inevitable fact of life and attention was given to ameliorating the consequences of prematurity rather than preventing its occurrence. This approach resulted in improved neonatal outcomes, but the cost implications in terms of both the suffering of infants and their families and the economic burden on society was enormous (Behrman, 2007). In a study done to determine the prevalence of singleton preterm delivery in Korle-Bu Teaching hospital was 9.6% (440/4731)(Nkyekyer, Enweronu-Laryea, & Boafor, 2006).

While not all premature babies experience complications, being born too early can cause short-term and long-term health problems for preemies. Generally, the earlier a baby is born, the higher the risk of complications. Birth weight plays an important role, too.

Some problems may be apparent at birth, while others may not develop until later.

In Ghana, data is not routinely collected on preterm and analysed as with low Birth Weight which the Midwives Form A captures into the District Health Information Management System (DHIMS). Although data on the proportion of preterm delivered within the institutions which can be obtained as a variable called 'maturity' are collected (as the gestational age from last normal menstrual period or early scan in the various registers in the maternity ward), it is not reported into the central database and so analysis is not readily done.

Many mothers of premature babies are concerned if they might be the cause of the preterm birth. However, in many instances, pregnancies that end up with preterm birth were uneventful. This is partly why prevention of premature birth is still in need of extensive research - without knowing the causes, a treatment is difficult.

There are several risk factors for preterm labor and premature birth, including ones that researchers have not yet identified. Some of these risk factors are "modifiable," meaning they can be changed to help reduce the risk. Other factors cannot be changed or modified known as "non-modifiable" risk factors.

These risk factors include maternal conditions, such as extremes of age, socio-economic status, preeclampsia, gestational diabetes, preterm Premature Rapture of Membrane (PPROM) and foetal conditions such as precious baby and foetal distress. This suggests a lowering of the threshold for preterm cesarean delivery. Further investigation will be required to determine whether this trend reflects optimal medical practice globally as well as in Ghana. Other antecedents of preterm births are multiple gestations arising from the

use of assisted reproductive technologies that involve implantation of multiple embryos and advanced maternal age.

In addition, surgical intervention for the management of cervical intraepithelial neoplasia or more invasive lesions is associated with an increase in the risk of preterm birth by a factor of approximately two (Castelo, 2012). According to Muglia & Katz (2010), the decision to induce preterm in order to improve foetal viability must be balanced by recognition of the need to minimise the impairment that arise from preterm birth. A steady decline in stillbirths has paralleled the increase in late preterm births (MacDorman, 2004). Making this decision will remain a challenge for practitioners since inducing delivery by whatever method before full term has adverse consequences for the newborn, even when it happens close to term(Muglia & Katz, 2010). The determinants of preterm delivery are largely unknown but the greater part of preterm delivery may be preventable. To stop premature labor, expectant mothers need to know the warning signs so that appropriate interventions can be put in place to prevent preterm labour. Acting fast by going to the nearest health facility for attention if she has any unusual feeling of getting into labor before they are due can make a big difference. For instance an expectant mother with urinary tract infection or malaria that can be the underlying cause of preterm contractions may be stopped by managing the condition with antibiotics or anti-malaria respectively and tocolytics.

Per the significant contribution of prematurity to morbidity and mortality, WHO, in collaboration with other world organizations, presented a new goal in 2010 to reduce mortality due to preterm birth by 50% between 2010 and 2025. Meanwhile, prematurity

is estimated as the leading cause of mortality in Ghana for the first month of life ranking the country at the 25th position in the world (UNICEF, 2013).

Due to the variability of the prevalence of preterm delivery across the world (differences between developed and developing countries), these occurrences has necessitated immediate scientific research to examine determinants of prematurity or preterm birth in Ghana. Ridge Regional Hospital (RRH), Greater Accra Region (GAR) is selected for the study due to peculiar and relevant secondary level services it provides and also it being the main secondary referral facility within the Ghana Health Service in Greater Accra Region. Undoubtedly, a foundational knowledge base of the determinants associated with preterm delivery in this study may reduce proportion of preterm delivery, the high preterm delivery morbidity rate and preterm specific mortality rate in Ridge Regional Hospital, Greater Accra Region.

1.2 Statement of the Problem

Globally, the main causes of neonatal deaths are preterm birth complications (35 percent), intrapartum-related complications (including complications during labour and delivery such as with asphyxia) (24 percent), and sepsis including neonatal tetanus and pneumonia (15 percent). The others are in the minority accounting for about 26 percent which include congenital malformations or anomalies and hereditary disorders(Liu et al., 2015). Preterm delivery (before 37 completed weeks of pregnancy) is a major public health concern causing over 1 million deaths annually and high rates of morbidity and disability among survivors

Also referred to us premature birth, preterm birth is the number one cause of death during the first month of life contributing about 30 - 40%, second only to infection contributing 20-30% infant and under-five mortality (Liu et al., 2015). Babies who make it often face a lifetime of medical setbacks. (Blencowe et al., 2013; Global Moms Challenge, 2012).

The contributing factors include the maternal sociodemographic, obstetric and pre-existing medical conditions, and that of the foetus.

Consequently, prevention of preterm birth has been a major focus of interest. Currently some interventions in place are optimal nutrition and care of the girl child to prevent earlier pregnancy among adolescents, care during the pre-pregnancy and pregnancy periods covered in the national maternal and child health strategies (2014-2018).The others are Cigarette smoking cessation, progesterone supplementation, cervical cerclage, decreasing multiple embryo transfers during assisted reproductive technologies, reduction of non-medically indicated labour induction or caesarean delivery (Chang et al., 2013).

With the current high preterm deaths in Ghana, it is such that it has implications on the economic, psychologic, socio- cultural, legal and the health of the baby and the family. The economic cost of preterm birth is high in terms of neonatal intensive care cost and ongoing health care and educational needs. The social implication is also high, with many families experiencing the sudden loss of a preterm baby or a stressful hospital stay (Pichler-Stachl et al., 2016), sometimes for months as well as the psychological and cultural acceptance of having a preterm and ultimately the loss of a newborn or infant while the parents are still alive (Blencowe et al., 2013,) (Baía et al., 2016).

Prematurity has a far-reaching impact on their development and on their health as children and adults. For a country like Ghana with a very high burden of preterm deaths, the solutions that require urgent implementation is to identify the determinants of preterm delivery for action to be taken. Therefore, if any impact can be made in reducing neonatal mortality of which prematurity is the leading cause; the risk factors leading to prematurity should be identified. It is upon this that this study seeks to examine the determinants of preterm delivery in Ridge Regional Hospital (RRH), Greater Accra Region (GAR).

1.3 Justification

In both developed and developing countries, many preterm births remain unexplained. Although some studies have been done in the developed world, limited studies have been done in the Ghanaian context. This study may help to review the epidemiology of preterm birth and may help us to know the determinants and ultimately make recommendations for efforts to improve the data and use the data for action to address preterm birth.

Thus, this study may provide evidence-based information on the determinants of preterm delivery in RRH, GAR in relation to maternal socio-demographic, maternal obstetric, maternal pre-existing pre-pregnancy medical condition (before pregnancy), and foetal determinants. It may add knowledge to the already existing published literature on determinants of preterm delivery. Finally it may help to develop new policy strategies by Ministry of Health in reducing preterm delivery and its complications and ultimately the neonatal mortality burden.

1.4 Conceptual framework

Premature delivery is influenced by several contextual and broad health care factors. The factors of interest in this study have been shown in the conceptual framework (Figure 1). The framework attempts to explain the influence of various factors of preterm delivery. Commonly, a pregnancy that may end up as preterm is usually uneventful .The proposed framework of determinants of prematurity take into account the factors that have been categorized into: Maternal socio-demographic determinants, maternal obstetric and gynaecologic determinants, maternal pre-existing medical conditions, and foetal determinants.

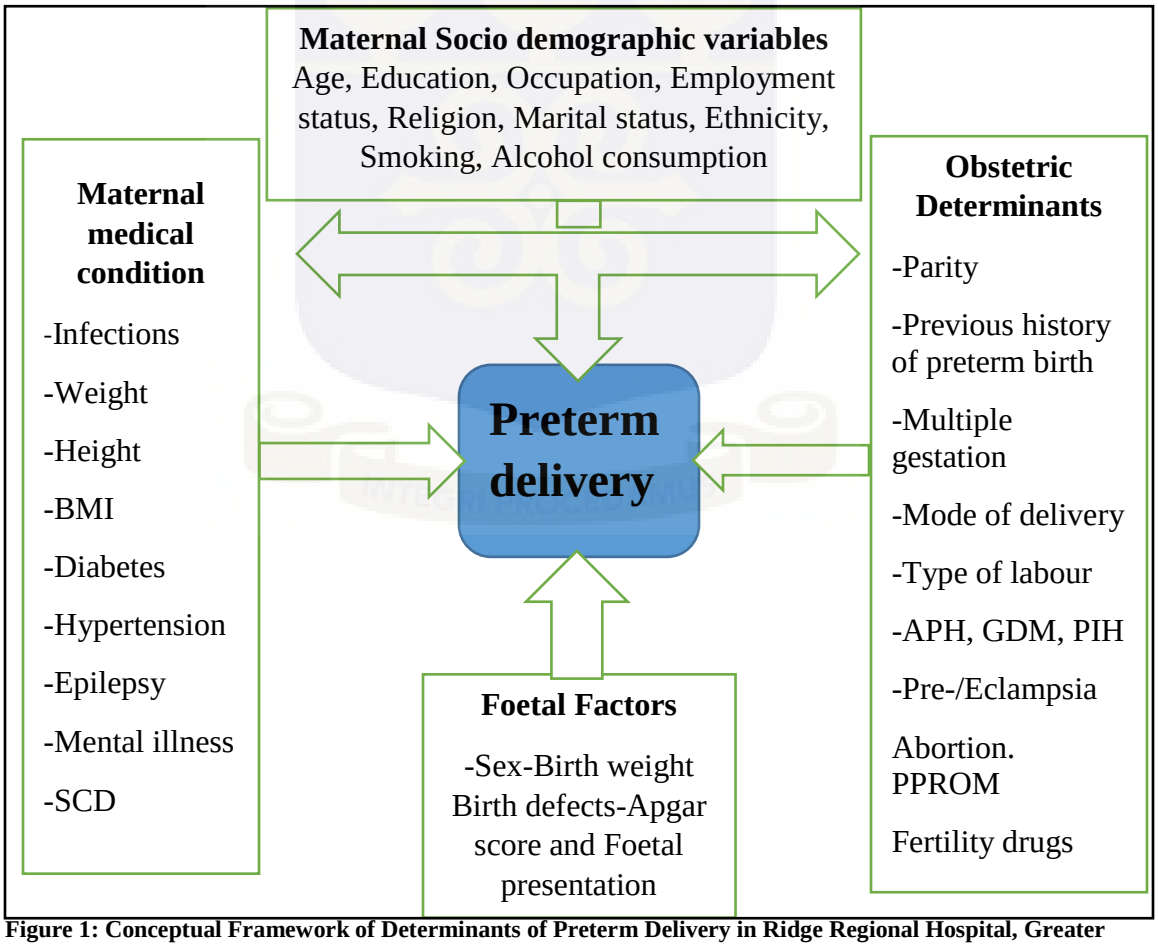

Figure 1: Conceptual Framework of Determinants of Preterm Delivery in Ridge Regional Hospital, Greater Accra Region

These factors act by themselves independently, collectively, and interact differently to impact on premature delivery. A better understanding of how these factors interrelate would be useful in the development of appropriate policy interventions that will contribute to the better understanding of the determinants of premature birth and ultimately reduce mortality as a result from prematurity.

World-wide, sociodemographic characteristics have been recognized to influence preterm delivery in both developed and developing countries. This model shows how the age of a mother may influence preterm delivery. Extremes of age are noted to mediate preterm delivery. The reproductive system of very young girls in the teenage period is not fully developed predisposing them to early labour. Likewise older women especially those who have been managing infertility may be exposed iatrogenically (Figure1). Marital status of a woman is also recognized as a factor influencing decisions to attend antenatal clinic and thus access to health care for early recognition and detection of medical complication which ultimately may impact on preterm delivery. Unmarried women may have their autonomy to seek health care compared to married women. However in the same instance, women who are married and also receive partner support are in a better state of being accompanied by their partners to antenatal clinic. Those married may also receive support from their partners in the form of taking care of the other children at home where applicable so that the woman can attend to her health care needs or give their wives money to attend antenatal clinic.

In many studies, short stature of the mother is associated with preterm delivery. In some instances, caesarean delivery may be the choice of preterm delivery in mothers with height below 1.5m. Similarly, weight of mother at registration also impacts on preterm

delivery. The body mass index of the mothers at registration and during the course of antenatal care has also been found to be associated with preterm delivery. In some instances, undernutrition is positively associated with preterm delivery and in other studies, overweight and obesity were contributing factors. Educational background becomes critical here as those who have higher education are better placed to be exposed to new knowledge that may encourage them to attend ANC compared to those with lower educational background. Similarly, higher socioeconomic status including employment status, occupation, and higher education may expose mothers to independence and autonomy in decision making improving financial accessibility thereby putting them in a better place to seek antenatal services thereby not requiring permission from their partners before accessing a healthcare facility. This may assist in early identification and diagnosis of complications such chronic hypertension, pregnancy-induced hypertension and its complications, chronic diabetes and gestational diabetes, epilepsy, mental illness and sickle cell disease so that preterm labour could be prevented (Figure 1).

Also the framework (Figure 1) explains the interrelationship between sociodemographic factors and obstetric factors. These include age and parity where older women managing infertility are sometimes iatrogenically delivered before term because the obstetrician does not want to take chances of losing the baby.

Pre-existing medical conditions independently and also interacting with obstetric conditions may also influence early delivery iatrogenically to save the life of the mother. Hypertension and its complications such as in chronic hypertension, pregnancy-induced hypertension, pre-eclampsia, eclampsia, may be an indication for the obstetrician to empty the uterus as quickly as possible even when the gestation is not term. Many

preterm labour is associated with preterm premature rupture of membrane. Spontaneous delivery may be allowed if there is no other medical or obstetric indication otherwise cesarean delivery may be the choice of delivery.

Infections such as urinary tract infection, malaria, HIV, HBV, Syphilis may all affect the mother forcing her into preterm labour. Abortion with cervical manipulation may predispose mother to incompetent cervix that has the potential to cause subsequent abortions and preterm delivery.

Looking at the foetal factors and preterm delivery, the sex of the baby may be a contributing determinant of preterm delivery. Typically the birth weight of a preterm a baby is likely to be low <2.5kg compared to term delivery. Birth defect may also be a contributing factor determining whether the delivery outcome will end up as preterm or not. Because foetal turning occurs in the third trimester, being born preterm tips the presentation in the direction of breech presentation. Together with parity of the woman, breech presentation will influence the mode of delivery. In this instance, caesarean delivery becomes the choice of delivery compared to spontaneous delivery. Apgar score is also associated with preterm delivery. In either the 1^{st} or 5^{th} minute, Apgar score <7 is a contributing determinant of preterm delivery.

1.5 Study Objectives

1.5.1 General Objective

To assess the determinants of preterm delivery in Ridge Regional Hospital, Greater Accra Region from October, 2015 to May, 2016.

1.5.2 Specific Objectives

1. To determine the proportion of preterm births in Ridge Regional Hospital, Accra rom October, 2015 to May, 2016.
2. To determine the maternal socio-demographic factors associated with preterm delivery in Ridge Regional Hospital, Accra from October, 2015 to May, 2016
3. To determine the maternal obstetric and gynaecologic risk factors associated with preterm delivery in Ridge Regional Hospital, Accra from October, 2016 to May, 2016
4. To determine the maternal pre-existing medical conditions associated with preterm delivery in Ridge Regional Hospital, Accra from October, 2016 to May, 2016
5. To determine the foetal factors associated with preterm delivery in Ridge Regional Hospital, Accra from October, 2015 to May, 2016.

CHAPTER TWO

2.0 LITERATURE REVIEW

2.1 Preterm Delivery

In the 20th century, preterm birth, defined as birth at less than 37 completed weeks of gestation was viewed as an unpredictable and inevitable fact of life. Medical interventions were geared towards managing the complications as a result of prematurity rather than preventing its occurrence. This approach resulted in improved neonatal outcomes, but the cost implications in terms of both the suffering of infants and their families and the economic burden on society was enormous(Behrman, 2007). A member of the MamaYe Coalition and Country Director of Evidence for Action (E4A), Prof. Richard Adanu, says Ghana should step up efforts to prevent preterm births by "providing quality emergency obstetric and newborn care facilities and adequately trained skilled birth attendants, especially in remote areas". He was speaking ahead of the World Prematurity Day, which is marked worldwide on November 17 (Young, 2013).

The Ministry of Health, Ghana report MOH, (2013) aligned prematurity (preterm birth), low birth weight, infections and asphyxia as primary causes of newborn death, yet, in a sharp contrast, it recounted that majority of infants or child deaths in Ghana are caused by conditions that are preventable or treatable with simple and low-cost interventions. What then could be these causal conditions? Knowing such causal factors might help to implement interventions or remedies that would be used to reduce these unfortunate but preventable mortalities.

Preterm birth has been identified to be a root cause of infant and child morbidity and mortality, but not so much is scientifically known of its determinants especially in the Ghanaian context. It is documented globally and even in Ghana that the major cause of newborn death and only second to all kinds of infections (pneumonia) in the infant and young child is prematurity. More often, preterm labor develops unexpectedly in a pregnancy that had been uneventful.

The world's preterm birth rate has been consistently rising in most countries with reliable trend data. Poulsen et al. (2015) observed that the proportion of preterm delivery among 12 cohorts studied in Europe to assess the educational disparity, singleton preterm live delivery proportion varied between 3.7% and 7.5%.(Poulsen et al., 2015). In 2010, an estimated 14.9 million babies or 11.1% of all live births were born preterm, indicating that, 1 out of every 10 babies are born before 37 weeks of gestation (Blencowe et al., 2013). According to Martin et al., (2015), the proportion of preterm birth declined for the seventh straight year to 11.4% in a study that looked at US birth data in 2013 according to a wide variety of characteristics. (Martin et al., 2015)

The rate of singleton preterm births has increased from 12.3% in 2003 to 12.7% in 2010 in the United States of America. Late preterm births (between 34 and 36 weeks of gestation) account for much of this increase; these births are often a consequence of interventions for medical indications (Loftin et al., 2010). A steady decline in stillbirths has paralleled the increase in late preterm births (MacDorman, Munson, & Kirmeyer, 2007). Trends in most other high-income countries are similar to those in the United States (Countries, Crimmins, Preston, & Cohen, 2011).

In high-income countries with reliable data, Loftin et al.(2010), observed that despite several decades of efforts, preterm birth rates appear to have increased from 9.4% in 1981 to 12.7% in 2010 although the United States reports a slight decrease in the rates of late preterm birth (34 to <37 weeks) since 2007(Martin et al., 2009). Recent estimates of preterm birth rates (all live births before 37 completed weeks) for 184 countries in 2010 and a time series for 65 countries with sufficient data suggest that 14.9 million (uncertainty range: 12.3– 18.1 million) babies were born preterm in 2010 (Blencowe et al., 2012). Currently between 2.4% - 18.3% of all births are preterm (Nabavizadeh et al., 2012);(Wagura, 2014).

According to estimates by the World Health Organization, among the 130 million infants born each year worldwide, 8 million die before reaching their first birthday (Zupan et al 2005). In the United States, 17% to 34% of these infant deaths are attributable to prematurity and only about half the cases of prematurity result from identifiable causes.

In a systematic review done by Beck et al. (2010), they estimated that in 2005, the bulk of the world's preterm deliveries were concentrated in Africa and Asia contributing 11 million (85%) of the 12.9 million births. Europe and North America (excluding Mexico) recorded half a million each whereas in Latin America and the Caribbean, they recorded nearly a million (Beck et al., 2010). However, in terms of rates, Africa and North America (11.9% and 10.6% respectively) were the highest compared to Europe (6.2%) being the lowest. In other studies, among 5400 live birth infants in Yasuj, Iran in 2010, 130 infants were premature (2.4%) (Nabavizadeh et al., 2012).

In a study done to determine the Prevalence and factors associated with preterm birth at Kenyatta National Hospital (KNH), the proportion of preterm birth was 18.3%.(Wagura,

2014). In Nigeria, prematurity and its complication remains a significant cause of early neonatal deaths and accounts for up to 60–70%. In a study done by Mokuolu et al. (2010), to determine the prevalence and determinants of pre-term deliveries at the University of Ilorin Teaching Hospital, Ilorin, 12% of the 2,489 deliveries that took place over a 9-month period were preterms(Mokuolu, Suleiman, Adesiyun, & Adeniyi, 2010).

The Global Action Report on Preterm Birth –prematurity- released in May 2012 puts the 2010 figures of preterm births in Ghana at 111,500 constituting 14.5 percent of live births recorded in Ghana. Out of this number, 7,800 died from preterm complications constituting 7%. Thus, premature specific mortality stands at 7% according to the report (MamaYe 2013).

In finding scientific answers to this question, this current study focuses its attention to determine the proportion of preterm delivery in Ridge Regional Hospital, Accra from October, 2015 to May, 2016, and to determine the factors of prematurity (or preterm birth); one of the primarily associated factors of infant and child mortality, in Ridge Regional Hospital, Greater Accra Region of Ghana.

2.2 Socio-Demographic Factors and Preterm Delivery

There are significant, persistent, racial, ethnic, and socioeconomic disparities in the rates of preterm birth. In 2003 a study observed that the preterm birth rate was in the following order; non-Hispanic African Americans had preterm births of 17.8%, 10.5% for Asian and Pacific Islander women and 11.5% for white women (Behrman, 2007).

Research has highlighted wide socio-economic inequalities in the rates of preterm birth however, the association between the two remain unknown(Smith, Draper, Manktelow & Field, 2009); (March of dimes, 2013).

Kramer et al. (2001) studied the association between socio-economic disparities in preterm birth where they hypothesized that there is an increased incidence of preterm delivery among the socially disadvantaged. They observed that chronic and acute psychosocial stressors, psychological distress caused by those stressors, increased secretion of placental corticotropin-releasing hormone (CRH), changes in sexual behaviours or enhanced susceptibility to bacterial vaginosis and chorioamnionitis were positively associated with preterm delivery (Kramer et al., 2001).

In a case-control study in Nigeria, low socio-economic class was significantly associated with preterm delivery (. Mokuolu, Suleiman, Adesiyun, & Adeniyi, 2010).

Mothers with low income had higher Odds of delivering preterm babies (Abdela Amanon, 2015). Sebayang et al. (2012) noted socioeconomic indicators such as mother's educational background, either rural or urban residence and household wealth were also related to preterm births (Sebayang et al., 2012).

2.3. Lifestyle Factors and preterm Delivery

Lifestyle factors have been found to be closely associated with preterm delivery. In very preterm (<32 weeks' gestation) new-borns, the impact of lifestyle factors on this group is well documented whereas in late and moderate preterm (LMPT) births (32–36 weeks of gestation) represent 75% of all preterm births, it is poorly understood (Moser, Macfarlane, Chow, Hilder, & Dattani, 2007).

In other studies, many lifestyle factors are closely linked to material and financial deprivation, and their detrimental effects on preterm birth have been reported. Key risk factors associated with preterm birth include smoking, (Miyake, Tanaka, & Arakawa, 2013) and excessive alcohol intake during pregnancy(Cornman-homonoff et al., 2012).

Also maternal psychological and/or physical stress, which are known to be associated with adverse lifestyle factors, may promote activation of neuroendocrine or pro-inflammatory pathways in favour of labour (Wadhwa et al., 2001).

Smoking in pregnancy is found to be associated with moderate and late preterm delivery. According to Smith et al. (2015) women residing in Leicestershire and Nottinghamshire, UK who smoked during pregnancy were at 38% increased risk of preterm delivery compared with non-smokers

Also women who ate food with low fruit and vegetables content were associated with a 31% increased risk compared with those who reported eating higher levels. The risk was even higher (5%) among women who smoked (Smith et al., 2015).

In another study by Kramer et al, (2001) in Montreal, Canada,, cigarette smoking or cocaine use, were positively associated with preterm delivery as well as low folate intake from the diet and from prenatal vitamin supplements(Kramer et al., 2001)

Contrary to other studies, Smith et al. (2015) observed no significant effect of alcohol or recreational drug use on preterm delivery. However, they concluded that Smoking cigarette and having meals free of or with low vegetables and fruits (poor diet) during pregnancy, predisposed mothers to preterm delivery in Leicestershire and Nottinghamshire, UK. They also suggested that stopping smoking in early pregnancy lowered the risk, thus an effective strategy to reduce preterm delivery(Smith et al., 2015).

In Denmark, 4.3% of the mothers studied had preterm delivery and it sought to evaluate the association between smoking during pregnancy and preterm birth and Wisborg et al. (1996) observed that mothers who smoked were at 40% higher risk of delivering preterm compared to those who did not smoke. Even the risk was higher (three-fold) among those who took more that 400g caffeine in addition to smoking (Wisborg, Henriksen, Hedegaard, & Secher, 1996). Similarly, studies done in Sweden confirmed the high risk of smoking and preterm delivery (Kyrklund-Blomberg, Granath, & Cnattingius, 2005).

Moderate alcohol consumption before and during the entire pregnancy period was not significantly associated with preterm delivery. However excessive alcohol consumption (>3 units/die) gave over 2 times the odds compared to those who did not take alcohol (Parazzini et al., 2003). In a meta-analysis of 36 earlier researches into alcohol consumption and the risk of preterm delivery in Canada, Patra et al. (2011) observed a strong association between alcohol drinking in pregnancy and preterm delivery (Patra et al., 2011).

2.4 Maternal Factors and Preterm Birth

Maternal age and birth order impacts on pregnancy duration. Xiong et al. (2015) after observing from other studies that among natural conception, advanced maternal age (>35 years) was significantly associated with an increase in preterm birth, they also specifically examined the association as relates to in vitro fertilization (IVF). They noted that advancing age reduced the risk of preterm delivery whereas mothers who opted for IVF conception before 30 years were at an increased risk of all stages of preterm delivery in the United States of America (Xiong, Dickey, Pridjian, & Buekens, 2015). The Birth order and interval were associated with preterm birth in a study where data used for these analyses were from 'The Supplementation with Multiple Micronutrient Intervention Trial' (SUMMIT), a cluster-randomised controlled trial (ISRCTN34151616) conducted in Lombok, Indonesia, (Sebayang et al., 2012).

A genetically informed study of the associations between maternal age at childbearing and adverse perinatal outcomes showed extremes of age favoring preterm delivery (Sujan et al., 2015).

Astolfi & Zonta, (1999) studied the risks of preterm delivery and association with maternal age, birth order, and foetal gender among Italian women. They observed that biological factors were associated more with advanced maternal age than with the male gender of the foetus which may influence premature onset of labour (Astolfi & Zonta, 1999).

In a systematic review done by Newburn-Cook & Onyskiw, (2005), that reviewed ten studies in Edmonton, Alberta, Canada to assess the risk factors for preterm delivery by

subtypes, they observed that advancing maternal age was significantly associated with spontaneous preterm delivery (Newburn-Cook & Onyskiw, 2005).

Similar to other studies, Astolfi & Zonta, (1999) found that among Italian women, maternal age less than 35 years resulted in preterm delivery well below 4% whereas in older mothers (⩾35 years) the frequency was twice as much. This difference was particularly striking among the first children born to mothers over 35 years (Astolfi & Zonta, 1999).

In a study in Brazil, there have been controversies over young maternal age and preterm birth. Instead, it was observed that after controlling for socio-economic and reproductive factors, the significance disappeared, thus indicating that social disadvantage rather than biological factors influenced preterm delivery. However, in other studies the association persisted after adjustment. (da Silva et al., 2003)

In younger age, 2 years of menarche, immature reproductive development in <16-year-old mothers was positively associated with preterm delivery. In (Astolfi & Zonta, (2002) delayed maternal age impacted in pregnancy outcomes including preterm delivery.

Birth order as relates to first or second born, there was significantly lower percentage of preterm babies found among second- compared with first-borns in Italy (Ulizzi et al., 1998); However, when looking at maternal age and birth order, the difference was particularly striking among the first children born to mothers over 35 years in Italy (Astolfi & Zonta, 1999).

According to Rao et al. (2014) in a case-control study on risk factors for preterm deliveries in a secondary care hospital, Southern India, the commonest non- obstetrical

risk factor was height <1.50 m (Rao et al., 2014). However in another study by Sebayang et al. (2012) that reviewed the association between Preterm delivery and the risk factors in Lombok, Indonesia, , height was not significantly related to preterm delivery (Sebayang et al., 2012). In a study done by Lao & Ho (1999) to examine the relationship between maternal height in teenage pregnancy in Hong Kong, height <150cm was found to be significantly associated to with preterm delivery.

In a study done by (Riley et al. (2016)), they noted that obesity was not associated with spontaneous preterm delivery despite all the controversies associated with increased body mass index (BMI) and pregnancy outcomes. In fact whenever BMI or weight increased, it had a decreased risk of preterm delivery at 32 to 36 weeks. Also, change in BMI or weight between pregnancies among maternally linked California births did not substantively alter results (Riley et al., 2016).

In another study done in the United States of America , Palatnik et al. (2016) observed conflicting evidence on the association between maternal weight and BMI, and spontaneous preterm birth (SPTB).They noted that spontaneous preterm delivery was less common among mothers with increased BMI (Palatnik, Miller, & Kominiarek, 2016).

In a study to assess interpregnancy weight change and risk of preterm delivery among Swedish women by Villamor & Cnattingius (2016), they noted that interpregnancy weight gain is related to increased risks of medically indicated preterm delivery. Equally high weight gain or loss in normal-weight women is associated with spontaneous moderately preterm delivery (Villamor & Cnattingius, 2016).

Typically, maternal educational levels have been found to be associated with preterm delivery. In a study to explore educational disparities in risk of preterm delivery: a comparative study of 12 European birth cohorts, they observed varied association between educational background and preterm delivery with 8 out of 12 cohorts favoring the disadvantaged education (Poulsen et al., 2015). Maternal educational level, which is generally accepted as a reliable indicator of the socio-economic status of the family, might at least partially account for variation in gestational age, because of the differences in availability of antenatal care.

In an evaluation done by Astolfi & Zonta (1999) among Italian women on risks of preterm delivery and association with maternal age, birth order, and fetal gender, maternal education, as expected, among the less educated mothers a significantly higher quota of preterm deliveries occurred (Astolfi & Zonta, 1999).

In a study involving 12 cohorts from across Europe, findings were consistent with mothers who were educationally disadvantaged with higher risk of delivering a preterm baby (Morgen, Bjork, Andersen, Mortensen, & Nybo Andersen, 2008). That study showed that the risk of preterm delivery was higher in mothers with <10 years of education compared with mothers with >12 years of education. In another study that reviewed United States of America birth records from the year 2000 to 2002, Schempf et al. (2007) observed that maternal age and parity-associated risks of preterm birth and the differences by race/ethnicity, young teenagers (<18), particularly multiparae, generally had a higher risk of each degree of PTB among all three racial/ethnic groups(Schempf, Branum, Lukacs, & Schoendorf, 2007)

2.4 Obstetric Factors affecting Preterm Delivery

Parity has been found to be associated with preterm delivery. In a study done in Yasuj in 2010, the preterm labour risk in women with two or more pregnancies was 5.5 times more than women with less than two pregnancies (Nabavizadeh et al., 2012).

In a systematic review and meta-analysis to look at parity and preterm delivery, Shah & Knowledge Synthesis Group (2010) observed that nulliparity was negatively associated with preterm delivery. In a similar study to determine effect of maternal age on adverse birth outcomes parity played a significant role where older women>40 years were at a higher risk of preterm delivery and even higher if they were nulliparous compared to younger women who were multiparous (Lisonkova et. al, 2010). Similarly, in a study done to determine the factors associated with preterm birth at Kenyatta national hospital (KNH), the Parity ≥ 4 was associated with preterm delivery(Wagura, 2014).

In general, most patients with a previous spontaneous preterm birth will deliver at term in a subsequent pregnancy but previous preterm delivery and in fact recurrent preterm delivery is strongly associated with a current preterm delivery especially if it was spontaneous labour (with intact or ruptured membranes)(Mazaki-Tovi et al., 2007). Previous history of pre-term delivery was strongly associated with a current preterm delivery (Mokuolu et al., 2010). A study done to determine the prevalence and factors associated with preterm birth at Kenyatta national hospital (KNH), also observed previous preterm birth was strongly associated with preterm delivery (Wagura, 2014).

Antepartum haemorrhage (APH) is one of the obstetric factors found to be associated with preterm delivery. In a study by Mokuolu et al. (2010), antepartum haemorrhage

(APH) was observed to be positively associated with preterm delivery(Mokuolu et al., 2010). In a study done to determine the prevalence and factors associated with preterm birth at Kenyatta National Hospital (KNH), pregnancy-induced hypertension (PIH), antepartum haemorrhage (APH), preterm premature rupture of membrane (PPROM) and urinary tract infection (UTI) were associated with preterm birth. Gestational hypertension, APH and prolonged Preterm PROM were independent determinants of preterm birth. (Wagura, 2014). Likewise, in another study by Samadi & Mayberry (1998), Antepartum haemorrhage independently positively impacted on preterm delivery (Samadi & Mayberry, 1998). Antepartum haemorrhage and Parity were predictors of early preterm birth while multiple gestation and UTI were strongly associated with late preterm delivery(Wagura, 2014).

Similar to Wagura, (2014), a study in KNH, Kenya, maternal urinary tract infection (UTI) had a significantly higher Odds compared to mothers who did not contract UTI during pregnancy (Mokuolu et al., 2010)

Similar to antepartum haemorrhage (APH), preterm premature rupture of the membranes (PPROM),independently is positively associated with prematurity (O. A. Mokuolu et al., 2010). Since obstetricians and neonatologist alike want to reduce infection to both mother and baby, antibiotics are given and a plan to empty the uterus by spontaneous delivery or by LUSCS. In a recent study in Ethiopia, it was observed that mothers who developed PROM during the current pregnancy had about 6.2 times increased risk of developing preterm birth (Abdela Amanon, 2015).

Another observation was major systemic comorbidities (preeclampsia, anemia) being key contributors to PPROM and medically indicated PTBs in a study aimed to determine the

prevalence and determinants of pre-term deliveries at the University of Ilorin Teaching Hospital, Ilorin.(Mokuolu et al., 2010)

Amanon (2015) noted in a study done in Ethiopia that mothers who had one or more complications in their pregnancy (PIH, APH, multiple pregnancies, polyhydramnios and cervical incompetence) were 2.9 times more likely of developing preterm birth than mothers without any of these mentioned problems(Abdela Amanon, 2015).

The commonest obstetrical risk factor for preterm birth was gestational hypertension and its complication in a study that aimed to identify the risk factors of preterm birth in a secondary care hospital in Southern India (Rao et al., 2014). Pregnancy-induced hypertension was noted to be positively associated with preterm delivery according to Mokuolu et al., (2010) in a study aimed to determine the prevalence and determinants of pre-term deliveries at the University of Ilorin Teaching Hospital, Ilorin.

Also in a retrospective cohort study of singleton births delivered in hospitals in the province of Québec, Canada, from 1989 to 2006, PTB rates were higher among mothers with comorbidity (10.9%) localized to the reproductive system such as placental abruption, chorioamnionitis, oligo-hydramnios, structural abnormality, cervical incompetence) compared to those without comorbidity (4.7%). These were more prominent among those at gestation < 32 weeks.

Multiple gestations have been found to be associated with preterm delivery. In a study to determine the prevalence and factors associated with preterm birth at Kenyatta national hospital (KNH), twin pregnancy was found to be positively associated with preterm delivery. It had a higher odds compared to singleton delivery. Similarly, it was observed

in another study that looked at maternal age and preterm births in singleton and twin pregnancies conceived by *in vitro* fertilisation in the United States where multiple gestation was noted to be a grave contributor and well-established fact determining preterm delivery.(Xiong et al., 2015).

Anaemia has been observed to be associated with preterm delivery. This observation was consistent with a study done in Ethiopia which showed that the odds of a pregnant woman with severe anaemia delivering a preterm baby was 7 times the odds of a woman with a normal haemoglobin(≥11g/dL) (Abdela Amanon, 2015). In a study to assess the risk factors for preterm birth in a population with high incidence of preterm birth and HIV infection in Malawi, anaemia was significantly associated with preterm delivery (van den Broek, Jean-Baptiste, & Neilson, 2014). In a systematic review and meta-analysis of 8182 articles, 29 and 26 respectively concluded that maternal anemia remains a significant health problem in low- and middle-income countries. In a study in Ethiopia to assess preterm birth and associated factors among mothers who gave birth in Debremarkos Town Health Institutions, , it was noted that mothers who attended antenatal clinic (ANC) and follow-up visit during the index pregnancy was found to be negatively associated (75% decreased risk) for preterm birth compared to those who did not attend ANC , (Abdela Amanon, 2015).

Also mothers who had not booked ANC were at a higher risk of preterm labour and delivery (Mokuolu et al., 2010).

Among the reasons for iatrogenic preterm delivery are maternal conditions, such as preeclampsia, and foetal distress. However, in the past decade, the number of preterm cesarean sections performed, regardless of gestational age, has increased by 33% to 50%,

Office for National Statistics (2014) without a similar change in maternal risk profiles.(Tindall 2011) The type of labour also was associated with preterm delivery (Mokuolu et al., 2010). There was a significant association between the incidence of spontaneous preterm delivery (P = 0.047) and maternal diabetes (Köck, Köck, Klein, Bancher-Todesca, & Helmer, 2010).Diabetes Mellitus significantly affects the gestational age and the incidence of spontaneous preterm delivery.

Lower Uterine Segment Caeseran Section (LUSCS) was strongly associated with nulliparous mothers compared to multiparous mothers who had spontaneous preterm delivery (Smith, Shah, Pell, Crossley, & Dobbie, 2007). In addition to obstetric conditions that have been found to be associated with preterm delivery, pre-existing maternal contitions have also been found to be associated with preterm delivery.

2.5 Pre-existing Medical Conditions in Pregnancy and Preterm Delivery

In a study in Yasuj, Iran on pre-existing medical conditions including a history of diabetes mellitus, thyroid dysfunction, cardiac disease and the risk of preterm delivery, it was observed that mothers were 2.3 times more at risk of preterm delivery if they were exposed to the above pre-existing medical conditions than healthy mothers(Nabavizadeh et al., 2012). Women with diabetes were 1.4 times and , hypertension were 3.2 times, at increased risk for a preterm birth(Johnson, Rottier, Luellwitz, & Kirby, 2009). In a recent study in Ethiopia, Abdela (2015) observed that mothers who had a history of chronic illness (diabetic Mellitus, hypertension, cardiac problem, or asthma) were 4.5 times more likely to have preterm birth in the subsequent pregnancy than mothers without history of these chronic illnesses (Abdela Amanon, 2015)

It was noted again, that women with low general health status were 2.9 times more at risk of preterm delivery than in women with normal general health status in the study done in Yasuj, Iran in 2010 (Nabavizadeh et al., 2012).

In a study 'premature delivery in diabetes: etiology and risk factors' comparing mothers who had gestational diabetes mellitus (DM) and preexisting DM, with normoglycemic women, it was observed that maternal DM was strongly associated with preterm delivery (Beigelman et al., 2000)

According to Samadi & Mayberry (1998) Preterm delivery were almost two times more likely for women who developed hypertension in pregnancy as compared with mothers who had a chronic pre-existing hypertension which was 1.5 times more likely(Samadi & Mayberry, 1998), The odds was even higher,(greater than four times for mothers with pregnancy-induced hypertension (PIH) compared with normotensive mothers. The odds of women with chronic hypertension and genitourinary infection increased preterm birth compared with women with pregnancy-induced hypertension and genitourinary infection(Samadi & Mayberry, 1998) .These findings are important in demonstrating the relation between the type of hypertension in pregnancy and preterm birth.

In a study done by Sven Cnattingius (2013), it was observed that in Sweden, maternal overweight and obesity during pregnancy were associated with increased risks of medically indicated preterm delivery. In fact as the BMI increased, from 25 toward 40 the risk of preterm delivery increased (Sven Cnattingius, 2013). Among nulliparae, the risk of elective preterm birth increased with increasing BMI. Nulliparae who were overweight and obese in early pregnancy were at a greater risk of elective preterm birth (PTB) than normal weight nulliparae (for the overweight).(Wang, Zhang, Lu, Xi, & Li, 2011).

In the study by Johnson et al. (2009) to assess maternal pre-pregnancy body mass index and delivery of a preterm infant in Missouri State, USA from 1998 to 2000 in each BMI category, the percent of women who delivered a preterm infant is: underweight 11.5%, normal 8.3%, overweight 8.2%, and obese 8.5%. For women with a BMI of overweight (odds ratio [OR] 0.9, 95% confidence interval [CI] =0.8-0.9) and obese (OR 0.8, 95% CI=0.8-0.9), the risk of delivering a preterm infant decreased when compared with women with a BMI<19.8 (Johnson et al., 2009),. In a systematic review and meta-analysis done to determine singletons born to underweight women, it was observed that underweight women have higher risks of PTB (overall, spontaneous and induced) and LBW than those born to women with normal weight (Han et al., 2011).

Pre-existing conditions sickle cell disease (SCD) is noted to be associated with poor pregnancy outcomes. In a retrospective study of birth size and maternal weight gain, in SC sickle cell disease mothers, there was poor weight gain, birth weight was low and were predisposed to early birth (Thame, Singh-Minott, Osmond, & Melbpurne-Chambers, 2016) In another study, in London-Middlesex (Canada), Brown et al.(1994) observed that the SCD cohort, overall rates of preterm (< 37 weeks), low-birth-weight (< 2500 g), and small-for-gestational age births were 9%, 10%, and 8%, respectively. Complication rates did not differ significantly by hemoglobin phenotype in the infants with SCD, but infants born to women with sickle cell anemia had higher rates of jaundice (Brown et al., 1994). In a study to assess whether sickle cell trait affect adverse pregnancy outcomes in the United State of America, results showed no significant bad outcomes (Kuo & Caughey, 2016). In another study that utilized Truven Health MarketScan Multi-State Medicaid databases used to assess the prevalence of maternal

complications among intrapartum and postpartum women 15–44 years of age with and without SCD whose race was reported as black complications to mother and baby were evident (Boulet, Okoroh, Azonobi, Grant, & Craig Hooper, 2013).

Drug dependence and mental disorders are also known to be associated with PPROM and spontaneous preterm births (PTBs) across all gestational ages according to Crump et al. (2011). . In a research to determine whether preterm birth is associated with epilepsy in a national cohort of Swedish adults aged 25–37 years, maternal epilepsy was found to have an association with preterm birth and epilepsy that increased by earlier gestational age. A similar but slightly weaker trend was observed for the association between preterm birth and antiepileptic drug prescription (Crump et al., 2011). These associations persisted after excluding individuals with cerebral palsy, inflammatory diseases of the CNS, cerebrovascular disease, and brain tumours suggesting that preterm birth, including late preterm birth, is strongly associated with epilepsy in Swedish adults aged 25–37 years. They noted that foetal growth was independently not mediated by cerebral palsy or other comorbidities(Crump, Sundquist, Winkleby, & Sundquist, 2011).

2.6 Foetal factors and Preterm Delivery

Foetal factors affecting preterm include sex of the baby, birth weight, birth defects or congenital malformations and Apgar score. It was previously believed that sex differentiation took place when the undifferentiated gonads formed either testes or ovaries. Studies in recent years indicate that sex differentiation begins at conception. In a study to determine foetal sex and preterm birth, male to female sex ratio was in favour of male being born preterm (Challis, Newnham, Petraglia, Yeganegi, & Bocking, 2013a). In another research to assess the gender aspect of preterm birth, Ingemarsson,

(Ingemarsson, 2003) noted that many males were born preterm compared to females. In a systematic review and meta-analysis done to study non-Asian population, Jaskolka et al. (2016) observed that male foetal sex is associated with preterm delivery(Jaskolka, Retnakaran, Zinman, & Kramer, 2016). Male foetuses were at increased risk of spontaneous preterm birth with intact membranes compared with a female foetus with a peak between 27 and 31 weeks(Peelen et al., 2016).

Other studies are in favour of male babies born preterm with associated morbidity and mortality (Schildberger & Leitner, 2016).

In a study done by Astolfi & Zonta (1999), male babies are known to have a significantly higher risk of being preterm than female babies (P. Astolfi & Zonta, 1999). This is similar to other researches that were done in the past also showed an increased males among preterms compared to term babies in most populations, including IVF births (Zeitlin et al., 2002) (Hall and Carr-Hill, 1982; McGregor et al., 1992; Cooperstock and Campbell, 1996), (P. Astolfi & Zonta, 1999).

However, the proportion of male births associated with preterm delivery declines with increasing gestation, even when time of conception is known. Astolfi & Zonta (1999) concluded that advanced age of the mother and male gender of the baby, contributes an increased risk of preterm delivery. Biological, most probably hormonal, factors related to maternal ageing seem more important than the sex of the foetus in determining the premature onset of labour (P. Astolfi & Zonta, 1999).

Studies to determine the socioeconomic disparities in preterm birth and birth weight in a non-Western developed setting: in Hong Kong's 'Children of 1997' birth cohort showed

significant association between birth weight and preterm (Leung, Leung, & Schooling, 2016a).

In a study done by (Davies, Pinto, & Bras, 2015), they observed a significant association with preterm delivery and low birth weight (<2.5kg).

Poor foetal growth is strongly associated with preterm delivery. The haemoglobin phenotype of infants with SCD and for that matter infants born to women with sickle cell anemia are at greater risk of preterm (Kuo & Caughey, 2016). Other studies showed neurodevelopmental birth defects associated with preterm birth(Schieve et al., 2016). In a study done in Nigeria, the authors found that poor foetal growth was strongly associated with preterm delivery (Iyoke et al., 2014)

In a study done to determine the association of cerebral palsy with Apgar score in low and normal birth weight infants using the Norwegian birth registry medical data, they noticed a significant association between APGAR Score and preterm delivery (Lie, Grøholt, & Eskild, 2010). However, in a similar study in Korle bu Teaching Hospital (KBTH) the authors noted that in categorizing the Apgar score into <7 and >7, there was no significant difference as relates to the risk of preterm delivery. Also, in a study to determine the prevalence and perinatal mortality associated with preterm births in a tertiary medical center in South East Nigeria, they noted a significant association between preterm delivery and Apgar Score (Iyoke et al., 2014)

Typically, foetal presentation was commoner in breech with preterm delivery. In a study by Bergenhenegouwen et al.(2016)) they investigated the effect of the mode of delivery in women with preterm breech presentation on neonatal and maternal outcome in the

subsequent pregnancy were likely to be delivered by caesarean section with better outcome of morbidity and mortality (Bergenhenegouwen et al., 2016)

Similarly, in another study by the same authors in 2015, they observed an association between the intended mode of delivery and perinatal morbidity and mortality among breech fetuses who are delivered preterm.(Bergenhenegouwen et al., 2015). Other studies have been done to examine neonatal morbidity and mortality rates by mode of delivery with breech presentation at term gestation (Lyons et al., 2015)

CHAPTER THREE

3.0 METHODS

3.1 Study Design

An unmatched case-control study was conducted. A questionnaire was developed to collect data on maternal and foetal factors from both cases and controls. Data was analysed .to determine the maternal and foetal factors associated with preterm delivery.

3.2 Study Area

The study was conducted in Ridge Regional Hospital, Greater Accra Region (GAR). GAR has the smallest area of Ghana's 10 administrative regions, occupying a total land surface of 3,245 square kilometres or 1.4% of the total land area of Ghana. It lies in the south-eastern part of the country along the Gulf of Guinea. It has a coastline of approximately 225 kilometres, stretching from Kokrobite in the west to Ada in the East. The vegetation is mainly coastal savannah shrubs interspersed with thickets.

The Greater Accra Region is bordered on the north by the Eastern region on the east by the Lake Volta on the south by the Gulf of Guinea, and on the west by the Central region. It is smallest region of Ghana in total area, and is made up of 16 administrative areas. The political administration of the region is through the local government system. Each District, Municipal or Metropolitan Area, is administered by a Chief Executive, representing the central government but deriving authority from an Assembly headed by a presiding member elected from among the members themselves.

Greater Accra Region has two major public universities and a number of private tertiary institutions spread through the region. . It has parks, recreational areas, national monuments, national historic sites.

Source: Google map/yahoo Inc.

Figure 2: Map of Ghana (upper) Accra (below) with the location of Ridge Regional Hospital

Demographics and Study Population

According to the 2010 Population and Housing Census, the region has a population size of 4,010,054 accounting for 16.3% of the country's total population making it the second largest region after Ashanti. Owing to in-migration, there is intercental growth rate of 3.1% and a population density of 1236 per sq./km. Greater Accra region has the highest proportion of urban population of 90.5 which is higher than the national average of 50.9% (Ghana Statistical Service (GSS), 2012b).The region has the highest (46.3%) proportion of populations who have never been married. With regional variations in the levels of school attendance, the region had 10.1% of its population who have never been to school and has the highest (8.3%) proportion of unemployed population. (GSS, 2012b).

Health Services

Currently, there is a regional hospital, 10 district hospitals, 12 polyclinics, 21 health centres and about 400 private, quasi-health facilities and small clinics dotted all over the region. These facilities serve the health needs of the over four million people in the region. More infants and young children are surviving and adults are living longer because of improved health care services in Accra (Fink, Weeks, & Hill, 2012). However there exists some cultural and religious resistance to the use of modern drugs to treat illnesses, resulting in fluctuating figures in the health indicators like maternal mortality rate, Infant mortality rate of which prematurity is a concern. (www.moh-ghana.org).

Ridge Regional Hospital was established by the British around 1928. Ridge Hospital was designated Regional Hospital in 1997. The hospital currently has a total of 191 beds and

falls within Osu-Klottey Sub Metro of the Accra Metropolitan Area with a population of 1,695,136. As a regional Hospital for Greater Accra Region, its catchment area includes the whole of the region with an estimated population of 4,283,322. It also serves the population of nearby regions including Kasoa and even to Winneba in the central region, Nsawam, Suhum, Aburi, in the Eastern Region and sometimes some areas from the Volta region. The hospital is accredited by the Medical and Dental Council for the training of House Officers in Medicine, Surgery, Obstetrics and Gynaecology, dentistry and also training of post graduate Residents in Paediatrics, Obstetrics and Radiology.

Ridge Regional Hospital is the main secondary referral hospital in Greater Accra Region providing Comprehensive Emergency Obstetric and Neonatal Care (EmONC). It has a NICU and receives neonates including preterms with or without complications. The Doctor - Population ratio is 1: 5103 and the Nurse - Population is 1: 874(Ghana Health Sector, Facts and Figures, 2010)

3.3 Variables

Dependent Variable

The dependent variable of interest was **Preterm delivery**

Independent Variables

The independent variables of interest collected from both the cases and controls were varied and grouped into Maternal Socio-demographic, Obstetric, Pre-existing medical conditions, and Foetal factors included in Table 1 below:

Table 1: Variables Determining Preterm Delivery

Maternal			Foetal
Socio-demographic factors	**Obstetric and Gynaecologic factors**	**Pre-existing Medical factors**	**Foetal factors**
-Age	-Parity	-Diabetes Mellitus	-Birth defects
-Education	-ANC visits	-Hypertension	-Head circumference
-Occupation	-Mode of delivery	-Sickle Cell Disease	-Chest Circumference
-Income level	-Cervical manipulation	-Heart diseases	-Full length
-Marital Status	-PIH - APH- PROM-GDM	-Body Mass index	-Apgar Score (1^{st} and 5^{th})
-Social support	-Pre/-eclampsia,	-Epilepsy	-Sex of baby
-Ethnicity.	-Abortion	-Mental Illness	-Birth weight
-Religion	-Fertility medications	-Jaundice/Liver disease	-Gestational age
-Residence	-Contraceptive use	-Anaemia/Hb at booking	
-Smoking cigarette	-Family history of preterm delivery	HIV,-HBV,-VDRL	
-Drinking alcohol,			

The gestational age was assessed by using date of last menstrual period and/or by ultrasound scan report in the records (early scan done after 12 weeks but before < 28 weeks used for dating). Operational definition of Socio-demographic characteristics in the study is shown in Table 2

Table 2: Operational Definitions of the Sociodemographic Characteristics

Variable	Operational Definition	Scale of Measurement	Source of data
Age	Age of mother at last birthday	Continuous-discrete in years	ANC book /interview
Educational level	Formal highest education attained	Ordinal None Primary Secondary Tertiary	Interview
Employment status	Mother's gainful job	Binary Employed Unemployed	Interview
Marital Status	Mother's legal marital status	Nominal Married Single Not married	Interview
Partner support	Support in the form of money, household chores, accompanying woman to ANC,	Binary Yes No	Interview
Family support	Support in the form of money, household chores, accompanying woman to ANC,	Binary Yes No	Interview
Religion	Religious denomination	Nominal Christian Islam Traditional	Interview
-Place of Residence	Place where mother lives at least 2 years before pregnancy	Binary Urban Rural	Ghana Statistical service
Smoking cigarette	Smoking cigarette	Binary Yes No	Interview
Drinking alcohol	Excessive alcohol drinking (>500mls of beer/>100mls of whisky)	Binary Yes No	Interview

The criteria used for defining the obstetric, pre-existing medical conditions and foetal determinants are shown in the subsequent Tables 3, 4 and 5 below

Table 3: Operational Definition Obstetric Determinants of Preterm Delivery

Obstetric and Gynaecologic condition	Criteria	Scale of Measurement	Source of Data
-Parity	The number of pregnancies carried to viable gestational age(≥28 completed weeks)	Nominal Nulliparity Primiparity Multiparity	ANC book/Interview
ANC visits	Number of ANC visits	Ordinal No visit 1-3 visits >4 visits	ANC book
Mode of delivery	How baby was delivered	Nominal Spontaneous Assisted LUSCS	ANC book
Cervical manipulation	Any manipulation to the cervix(EOU, D&C, DD&C)	Binary Yes No	Interview
Gestational diabetes mellitus	-Positive Urine glucose confirmed by Fasting plasma glucose ≥7mmol/L	Binary Positive Negative	ANC book
Pregnancy induced hypertension	-Systolic blood pressure ≥140 mm Hg and/or Diastolic blood pressure ≥90 mm Hg	Binary Yes No	ANC book
Pre –eclampsia	Elevated blood pressure with urine protein	Binary Yes No	ANC book
Eclampsia	Elevated blood pressure with a seizure/fit	Binary Yes No	ANC book
Abortion	Expulsion of foetus before 28 weeks of gestation	Binary Yes No	Interview/ ANC book
PPROM	Loss of liquor confirmed by USG	Binary Yes No	ANC book/ Interview
Antepartum haemorrhage	-Bleeding in pregnancy after 28 weeks of gestation	Binary Yes No	Interview/ ANC book

Table 4: Operational Definition of Pre-existing Medical Conditions in Preterm Delivery:

Clinical condition	Criteria	Scale of Measurement	Source of Data
Chronic diabetes	-Positive Urine glucose confirmed by Fasting plasma glucose ≥7mmol/L	Binary Yes No	ANC book
Sickle Cell disease	Laboratory testing of sickling status	Binary Positive Negative	ANC book
Chronic hypertension	-Systolic blood pressure ≥140 mm Hg and/or Diastolic blood pressure ≥90 mm Hg	Binary Yes No	ANC book/ Interview
-Anaemia -Severe Anaemia	-Haemoglobin <11.0 g/dl -Haemoglobin<7g/dl	Binary Yes No	
Body Mass Index (BMI) Kg/m^2	Calculated from Weight (kg) / Height $(m)^2$	Nominal Underweight (<19) Normal(19-25) Overweight (26–29) Obese (>30)	ANC book
Epilepsy / Mental illness	Neurological condition diagnosed clinically	Binary Yes No	ANC book/ Interview
Jaundice/Liver disease	Clinical condition with yellowing of eyes and skin confirmed in the laboratory by bilirubin level	Binary Yes No	ANC book/ Interview

Table 5: Operational Definitions of Foetal determinants of Preterm Delivery

Foetal condition	Criteria	Scale of Measurement	Source of data
Stable baby	Apgar Score of >7 in 1st and 5th minute after delivery with birth weight >1.5kg	Binary Yes No	Head ticket/ Pink card
Apgar Score	Apgar score calculator Appearance – 2 Heart rate – 2 Grimace – 2 Activity -2 Respiratory rate – 2	Ordinal Poor (<4) Moderate (4-7) Good (>7)	Head Ticket/ Pink card
Birth defect	Any abnormality detected at delivery	Binary Yes No	Head Ticket/ Pink card
Birth weight (kg)	Weight of baby at birth	Ordinal Low (<2.5 kg) Normal (>2.5kg)	Head Ticket/ Pink card
Sex of baby	Sex of baby at birth	Nominal Male Female	Head Ticket/ Pink card

3.4 Sampling

3.4.1. Study Population

All mothers who came to deliver in Ridge Regional Hospital, as well as mothers who were referred from other hospitals in Greater Accra Region to Ridge Regional Hospital for obstetric or neonatal care services. All term and preterm babies born to their mothers-singleton and multiple outcomes-twins, triplets, quadruplets etc. were part of the study population.

All preterms that were delivered at the time of the study were selected as cases. For controls, a term delivery immediately before and after the selected preterm delivery was selected as control. Cases were identified as mothers who delivered between 28 and 36 weeks whereas controls were mothers who delivered between 37 completed weeks and 42 weeks. Cases were unmatched with controls in a ratio of 1:2. This ratio was chosen because preterm delivery (disease) is known to be rare and there is a fairly large number of deliveries (exposed individuals) but most of these did not end up as preterm deliveries (are not diseased). Thus it is a technique for adding power to this study. Typically for statistical reasons, however, there is little gained by including more than two controls per case. In some instances it can go up to 4:1 if the condition is very rare.

3.4.2 Sample size

Sample size was 390 mother and baby pairs comprising 130 mothers who delivered preterm (cases) and 260 mothers who delivered term (controls).

Calculation of the sample size was done as follows:

A ratio of 1 case to 2 Controls was adopted and 95% Confidence Interval at 5% level of Significance was applied. Assuming 50% of controls exposed, and 66% of cases exposed with a power of 80% to detect an odds ratio of 2. This assumption was based on the fact that, all pregnant women are exposed to preterm delivery. However, the actual outcome is rare. It is also known from literature that there are some variables that predispose pregnant women to preterm delivery compared to other variables. Thus in such a study, the variable of exposure in the controls exposed was 50% and that for cases exposed was 66%. Putting the figures into the Epi info 7 Unmatched Case Control Stalcal formula, it generated a sample size of 309 with 103 cases and 206 controls

Using the Fleiss formula and allowing for about 10% non-response rate or losses, the sample size was rounded it over to a total estimated sample size of 360 mothers comprising 120 mothers who had preterm births (cases) and 240 mothers who had term births (controls).

3.4.3 Sampling method

The Ridge Regional Hospital was purposely selected as it is the regional hospital and the main Ghana Health Service secondary referral centre in Greater Accra Region and provides comprehensive Emergency Obstetric and Neonatal Care. Average monthly delivery was between 700 and 800 but the proportion of preterm delivery is relatively small approximating 5.5% to10%. Ridge Regional Hospital has a Neonatal Intensive Care Unit to manage both complicated term and preterm babies and provides services under the National Health Insurance Scheme (NHIS).

Within Ridge Regional Hospital, mothers were identified from the labour ward delivery register and then followed to the post-natal ward. The post-natal ward is where the mothers are observed until they have recovered from the delivery process before discharged home. The other sources of mother identification included mothers who reported to the NICU clinic for the first post discharge visit, the Post Natal Clinic where mothers were expected to attend the second post-natal care visit and the Child welfare Clinic where mothers bring their babies for the first visit to be examined and given the six week's post-delivery immunisation.

Three categories of mothers were included here as cases. Mothers who delivered preterm babies with medical complications and so admitted to the NICU; mothers who delivered preterm babies without any medical complications but their birth weight was less than 1.5 kg and so admitted to Kangaroo Mother Care ward after observation in the NICU and mothers who delivered preterm babies without any medical complications warranting admission and their birth weight was greater than 1.5kg and discharged home. Controls were identified as mothers who delivered term babies. The sample size was estimated as all preterm deliveries identified and selected as cases and the two controls selected as the term delivery immediately before a preterm delivery and immediately after a preterm delivery to reach the sample size.

3.5 Case Definition

Case: A mother who delivered a preterm in Ridge Regional Hospital, Greater Accra Region from October, 2015 to May, 2016

Control: A mother who delivered a term baby in Ridge Regional Hospital, Greater Accra Region from October, 2015 to May, 2016.

Inclusion criteria

Cases- All mothers who delivered preterm babies in Ridge hospital either spontaneously or by Lower Uterine Segment Caesarean Section (LUSCS) and have been transferred to the post-natal ward, Kangaroo Mother Care (KMC) ward; or those discharged and had come to the post-natal clinic or child welfare clinic

Control – All mothers who delivered a term baby in Ridge hospital either spontaneously or by LUSCS and have been transferred to the post-natal ward, ward; or those discharged and had come to the post-natal clinic or child welfare clinic

Exclusion criteria

Cases and Control - All mothers who delivered spontaneously with any delivery complication, by LUSCS and had not yet mobilised, still had their urinary catheter in situ and those admitted to the high dependency unit of the post-natal ward (were considered not fit to consent to participate as well as those whose babies were in the NICU in critical condition making them psychologically unstable

3.6 Cases and Control Selection

Cases Selection

All Preterm deliveries that occurred in Ridge Regional Hospital and their babies admitted to Neonatal Intensive Care Unit (NICU), Kangaroo Mother Care (KMC) ward or discharged home between October, 2015 and May, 2016 were selected. Mothers were identified from the labour ward or theatre and then followed to Post-Natal ward, Post

Natal Clinic, NICU, NICU clinic, KMC ward and Child Welfare Clinic (CWC). Where the mother had recovered fully from the delivery process without any medical complications and was ambulant, she was considered stable and fit for interview if she consented. These mothers were engaged for possible enrolment into the study. Data was extracted from the delivery register, in-patient folders, maternal health record books (ANC books) where available and the head ticket (pink card for the newborn). A face to face interview was carried out to complement the information from records as well as augment the missing variables being collected. Where the data was not recorded and the measurement was likely not to change such as for height of the mother, this was checked using a stadiometer at the antenatal care/postnatal care clinic or the child welfare clinic and recorded appropriately. However, other variables such as weight, blood pressure, urine protein and sugar which were likely to change per ANC visit were excluded if they were not available, In the event that some mothers refused to or did not consent to be part of the study, we continued with the rest until we got our minimum case sample size.

Control Selection

Two controls were selected per preterm delivery. The first was a mother who delivered a term baby immediately before the selected preterm delivery. The second mother was selected immediately after the selected preterm case. This sampling method was employed because the proportion of controls to cases is greater than 0.85. List of selected controls was used to extract records from the delivery registers, in-patient folders, maternal health records book and the neonatal pink card. A face to face interview was carried out to complement the information from records as well as augment the missing variables being collected. Where the data was not recorded and the measurement was

likely not to change such as for height of the mother, this was checked using a stadiometer at the antenatal care/postnatal care clinic or the child welfare clinic and recorded appropriately. However, other variables such as weight, blood pressure, urine protein and sugar which were likely to change per ANC visit were excluded if they were not available, In the event that a mother refused or did not consent to be part of the study, we used the same approach and selected the immediate term delivery preceding that term delivery (who refused) or the term delivery following the term delivery that refused

3.7 Data collection technique and tools

A structured data capture sheet was designed to abstract the hospital maternal health records. A face to face interview with mothers included in the study from the post-natal ward, kangaroo mother care ward, Neonatal Intensive Care Unit, post-natal care clinic, NICU clinic and the child welfare clinic was conducted to complete the maternal demographic, socio-economic, obstetric, medical and foetal factors that were not documented. The tool captured antenatal visits at booking, subsequent visits- through 28 weeks, 36 weeks, and obstetric, maternal medical records as well as the socio-demographic variables of mothers and births.

3.7.1Training of Interviewers

The field workers were trained a week prior to the commencement of the data collection. The training focused on ensuring that the field workers understood the objectives of the survey, were familiar with the survey tools and their interpretation, and were able to perform the survey task. Simulated practices were repeated to increase the agreement and consistency between the field workers and the principal investigator (PI). Training and concordance testing was done aiming to achieve at least 90% agreement of practice results between field workers and the principal investigator.

The trained survey team (data collectors, and midwives/ paediatric nursing staff) were recruited from their respective units in Ridge Regional Hospital where the data were collected.

Together with the survey team, we attended the weekly (Tuesday) paediatric department meeting and daily (Monday) Obstetrics and Gynaecology department meeting to

introduce the research to the various staff in the units and sought permission and support to collect the data.

3.7.2 Data Quality control

The following measures were instituted at various stages of the study to ensure quality data was generated for the analysis. The data collection tools were pre-tested to ensure quality data capture during the study. Field workers preferably staff with experience in neonatal care including midwives, paediatric nurses, and NICU nurses in their respective units were recruited for the collection of data to ensure quality. Also, the field workers were trained and assessed with concordance testing to ensure they have the ability to accurately record the participants' answers or responses to questions. During the data collection, the principal investigator actively collected data as well as supervised the field workers and about 10% of the completed forms containing raw data were randomly selected and crossed-checked from the participants to identify errors and/or omissions correctness or corrective action was made.

The data entry clerks were also trained to ensure quality entries and similarly, checks were repeated during the entry. Entry of the data into an electronic database (Epi Info7) was done by 2 independent entry clerks and discrepancies resolved by referring to the original data collection tools. Data validation was ensured during the data entry process by using a validation programme.

3.8 Data processing and analysis

Data was coded and entered into a predesigned software tool Epi Info version 7 using double entry technique by 2 independent data entry clerks. Data was verified and cleaned to ensure good quality, and then exported to STATA-13 for analysis.

Descriptive Statistics – Descriptive data analysis was done using frequencies and two by two cross tabulation. Univariate analysis of categorical variables was expressed in the form of frequencies, proportions and percentages. Frequencies of cases and controls were run to ascertain the completeness of each independent variable. The percentages of the cases and controls of independent variables were calculated from the frequencies. Appropriate measures of central tendencies and dispersion were calculated for continuous data.

Inferential Statistics: Bi-variable data analysis was done for all the independent variables including maternal age, marital status, partner and family support, employment status, parity, mode of delivery, number of babies delivered, chronic hypertension, chronic diabetes, sickle cell disease mental illness, baby's birth weight, sex of baby delivered foetal presentation and Apgar score. Chi-square analysis was done to detect any statistical significance and simple logistic regression was also run to show the strength of association. The variables which were significant as well as those proven to be biologically plausible in literature to be risk factors for preterm delivery were put into a multiple logistic regression model and run to detect significant determinants. This analysis was done using odds ratio and their corresponding 95% Confidence Interval to assess association between selected independent variables such as maternal age, highest educational level, employment status, marital status, partner support parity, (maternal

socio-demographic factors) pregnancy induced hypertension and its complications, antepartum haemorrhage, premature rupture of membrane, (obstetric factors), chronic hypertension, chronic diabetes anaemia (pre-existing medical conditions complicating the pregnancy) and foetal variables (birth weight, foetal presentation, Apgar score (foetal factor) and appropriateness of premature delivery factors.

3.9 Ethical Consideration

Ethical approval was sought from the Ethical Review Committee of the Ghana Health Service. Permission was sought from the Greater Accra Regional Health Directorate, to use the Ridge Regional Hospital as my study site.

Informed consent was obtained from mothers and confidentiality assured before the study. They were fully informed about the purpose, procedures, risks and benefits of participating in the study. For participants who could not read the consent form, it was read and explained to them in the presence of an impartial witness (preferably another clinical staff who knows about the study but not a field worker). Participants who agreed to be part of the study were required to sign or thumbprint the consent form as an indication of their willingness to participate as well as to give information about the newborn.

All the information obtained from this study is being kept confidential and used for the purpose indicated for the study. The information will be securely stored without the names of the participants in a file which will be accessible only to the research team. Each name was assigned an identity code and will be kept confidential. Extraction of data from the mothers' records was done by trained health professionals and researchers

including the principal investigator who have experience in the management of patients' records and information.

There was no risk involved in participating in this study. The participants were however informed of possible minor discomfort or sad memories, reminders of sad moments in answering certain questions for which they may choose even not to answer. Also, participation was voluntary and they could withdraw at any time from the study without attracting any penalty. They were not coerced into taking part in this study and there was no direct benefit or compensation for participation.

3.10 Pre-testing and review of data collection tools

The data collection tool was pre-tested in Adabraka Polyclinic. This health facility used to be the polyclinic of Ridge Regional Hospital and is in close proximity to it. The basic conditions at Adabraka Polyclinic as relates to the clients who visit there for maternal care services are similar to what pertains at Ridge Regional Hospital. Pretesting was done to assess the understanding of the data collection tool, time taken to complete it, make the necessary modifications to ensure they reflected the local conditions and that the questions were clear and well understood by the respondents.

CHAPTER FOUR

4.0 RESULTS

4.1 Preterm Delivery

The study recruited a total of 390 mothers who delivered in Ridge Regional Hospital comprising 130 cases (preterm deliveries) and 260 controls (term deliveries).

Out of the 130 preterm deliveries, 36(28%) were classified as early preterm (28 - 32 weeks gestation) and 94 (72%) were moderate to late preterm (33 -36 weeks gestation) based on the WHO classification Another classification used by Ridge Regional Hospital was early to moderate preterm 92 (70.2%) and Late preterm 38 (29.2%).

There were 5215 total deliveries, of which 796 were preterm giving the proportion of preterm delivery for the period as 15.3% between October, 2015 and May, 2016. Based on the Ridge Regional Hospital classification, 8.0% were early to moderate preterm and 7.3% were late preterm (Figure 4).

4.2 Sociodemographic characteristics of the study participants

Out of 390 mothers, those aged between 20 and 34 were of the majority, contributing 297 (76.2%), while mothers in the teenage group (15years to 19years) were 22(5.6%).

Short stature of mother was in the minority. Twenty- one (5.4%) of the mothers were below the height of 150cm. There was no difference in height between the proportion in both categories of preterm and term. At booking, 198 (51%) of the mothers had normal Body Mass Index (BMI) of 19-25 and 170 (44%) of the mothers had BMI above normal of >25. Within the category of above normal BMI (> 25), 46% were preterm and 42% were term.

In all, 272 (69.7%) mothers were married. Of this, 62.3% were preterm and 73.5% were term. Out of the 118 (30.2%) mothers who were not in the marriage bracket, 38% of them had preterm deliveries compared to 26% who were in the control arm (Table 6).

Table 6: Association between Socio-demographic Characteristics and Preterm Delivery

Maternal exposure	Preterm (%) N=130	Term (%) N=260	Total (%) N=390	P-value
Maternal age(years)				0.58
15-19	8 (6.2)	14 (5.4)	22(5.6)	
20-34	102(78.4)	195 (75.0)	297(76.2)	
>35	38 (15.4)	75 (19.6)	113(18.2)	
Maternal height(cm)				0.63
<150	8(6.2)	13(5.0)	21(5.4)	
≥150	122 (93.9)	247 (95.0)	378 (94.6)	
BMI (kg/m2)				0.80
< 19 (Undernutrition)	6 (4.62)	16 (6.2)	22 (5.6)	
19 – 25 (Normal)	64 (49.2)	134 (51.5)	198 (50.8)	
26 – 30 (Overweight)	34 (26.2)	58 22.3)	92(23.6)	
>30 (Obese)	26 (20.0)	52 (20.0)	78 (20.0)	
Marital status				0.08
Married	81(62.3)	191 (73.5)	272 (69.7)	
Single	18 (13.9)	24 (9.2)	42 (10.8)	
Not married	31 (23.9)	45 (17.3)	76 (19.5)	
Educational status				0.91
No formal education	10 (7.7)	17 (6.5)	27 (6.9)	
Primary	67 (51.5)	128 (49.2)	195 (50.0)	
Secondary	37 28.5)	78 (30.0)	115 (29.5)	
Tertiary	16 (12.3)	37 (14.2)	53 (13.6)	
Occupation				0.98
Artisans	50 (38.5)	102 (39.2)	152 (38.9)	
Trader	57 (43.9)	111 (42.7)	168 (43.1)	
Civil servant	18 (13.9)	35 (13.5)	53 (13.7)	
None	5(3.9)	12(4.6)	17 (4.4)	
Employment status				0.61
Employed	99 (76.2)	204 (78.5)	303 (77.6)	
Unemployed	31 (23.9)	56 (21.5)	87 (22.3)	
Partner support				**0.02**
Yes	115 (88.5)	247 (95.0)	362(92.8)	
No	15 (11.5)	13 (5.0)	28 (7.2)	
Family support				0.51
Yes	78(60.0)	147 (56.5)	225(57.7)	
No	52(40.0)	113 (43.5)	165(42.3)	

A higher percentage of the mothers 222(56.9%) had their highest educational level to be below secondary education. Fifty-three (14%) of the mothers had tertiary education with similar proportions between preterm and term

Traders formed the highest occupational group – 168(43%) and the least was those who were housewives and students (4.4%).

Mothers who were in employment were 303 (78%) of which 204(79%) had term deliveries. Among the unemployed group 24% of the mothers had preterm delivery and 22% had term delivery. Three hundred and sixty-two (93%) of mothers had support from their partners. Of this figure, 115 (88%) were preterm whereas 247(95%) were term. Here the support included accompanying them to antenatal clinic, giving them money to attend the clinic, helping them with home chores and providing a helping hand with the other children where available. Of the 28(7%) who did not receive any support from their partners, 12% delivered preterm and 5% had term deliveries. Majority of the mothers had family support during the pregnancy. These included support from blood relatives providing a helping hand with taking care of the other children and providing monetary support where applicable, helping them with home chores in order to free them to attend antenatal clinic and to also have intermittent rest.

The socio-demographic determinants associated with preterm are shown in Table 6. At the bivariate analysis level, only partner support was found to be significantly associated with preterm delivery (p=0.02). The odds of preterm delivery among mothers who did not receive support from their partners was 2.5(95%CI 1.1-5.4) times the odds of those who received partner support.

Maternal age at time of booking at the antenatal clinic did not show significant association with preterm delivery P=0 58). The height of the mother at the time of registering at the antenatal clinic did not have a significant association with preterm delivery (p=0.63). Similarly, body mass index at booking which was calculated from the weight of mother at time of registration in kilogram divided by the square of the height in meters was not significantly associated with preterm delivery (p=0.8). Whether the mother had received formal education or not was not significantly associated with preterm delivery (p=0.08). It did not matter the occupation of the mother. Mothers who were neither employed nor unemployed were not significantly associated with preterm delivery (p=0.61). Unlike partner support, even though a higher proportion of the mothers received support from their family, it was not significantly associated with preterm delivery (p=0.51). However, all variables which were not significantly associated with preterm delivery had varied odds with some showing higher risk of preterm delivery and others protective.

At the multivariate level of analysis, partner support remained significantly associated with preterm delivery. Thus, the odds of a mother not receiving support from her partner was increased by 2.5 (95%CI 1.1-5.4) times in delivering a preterm compared to mothers

who received support from their partners. Similarly as shown in the bivariate analysis, the socio-demographic variables were not significantly associated when adjusted (Table 7).

Table 7: Adjusted Odds Ratio of Socio-demographic Characteristics and Preterm Delivery

Maternal exposure	N=390	(%)	OR (95%CI)	*p*-value	AOR (95%CI)	*p*-value
Maternal age				0.58		
15-19	22	5.6	1.1(0.4-2.7)	0.85		
20-34	297	76.2	1			
>35	71	18.2	0.7(0.4-1.3)	0.32		
Maternal height				0.64		
<1.5	21	5.4	1.2(0.5-3.1)	0.64		
≥1.5	369	94.6	1			
BMI				0.80		
< 19 (Undernutrition)	22	5.6	0.8(0.3-2.1)	0.63		
20 – 25 (Normal)	198	50.8	1			
26 – 30 (Overweight)	92	23.6	1.2(0.7-2.1)	0.44		
> 30 (Obese)	78	20.0	1.0(0.6-1.8)	0.59		
Marital status				0.08		
Married	272	69.7	1			
Single	42	10.8	1.8(0.9-3.4)	0.09		
Not married	76	19.5	1.6(1.0-2.7)	0.07		
Educational status				0.90		
No formal education	27	6.9	1			
Primary	195	50.0	0.9(0.4-2.1)	0.78		
Secondary	115	29.5	0.8(0.3-1.9)	0.63		
Tertiary	53	13.6	0.7(0.3-1.9)	0.54		
Occupation				0.98		
Artisans	152	39.0	1			
Trader	168	43.1	1.0(0.6-1.5)	0.85		
Civil servant	53	13.5	1.0(0.5-1.8)	0.89		
None	17	4.36	1.2(0.4-3.5)	0.77		
Employment status				0.61		
Employed	303	77.7	1			
Unemployed	87	22.3	1.1(0.7-1.9)	0.61		
Partner support				**0.02**		**0.04**
Yes	362	92.8	1			
No	28	7.2	**2.5(1.1-4.5)**	**0.02**	**2.5(1.1-4.5)**	**0.02**
Family support				0.36		
Yes	225	57.7	1			
No	165	42.3	0.9(0.6-1.3)	0.51		

4.3 Obstetric and Gynaecological Determinants of Preterm Delivery

In this study, number of Antenatal Care visits (p= <0.001), mother having Ante Partum Haemorrhage (APH) (p=0.05), number of babies delivered (p=<0.001), mode of delivery (p=0.02), having preterm or term, Premature Rapture of Membrane (PROM) (0.03), Pregnancy Induced hypertension (PIH) (<0.001), severe pre-eclampsia/eclampsia (<0.001) and previous mode of delivery (p=0.02) were found to be significantly associated with Preterm delivery (Table 8a and 8b)

Table 8a: Association between Maternal Obstetric Determinants and Preterm Delivery

Maternal exposure	Preterm (%) N=130	Term (%) N=260	Total (%) N=390	P-value
Parity				0.93
Nullip	44(33.9)	83 (31.9)	127 (32.6)	
Primip	32 (24.6)	66 (25.38)	98 (25.1)	
Multip	54 (41.5)	111 (42.7)	165(42.3)	
No. ANC visit				**<0.001**
1-3	55 (43.3)	29 (11.2)	84(21.8)	
≥4	72 (56.7)	230 (88.8)	302 (78.2)	
APH before				**0.05**
Yes	15(12.2)	15 (6.2)	30 (8.2)	
No	108 (87.8)	229 (93.9)	337 (91.8)	
Babies delivered				**<0.001**
Singleton	117 (90.0)	255 (98.08)	372 (95.38)	
Multiple	13 (10.0)	5 (1.92)	18 (4.62)	
Mode of delivery				**0.02**
Vaginal	44 (33.9)	119 (45.8)	163 (41.8)	
LUSCS	86 (66.2)	141 (54.2)	227 (52.3)	
(P)PROM labor				**0.03**
Yes	46 (35.4)	64(24.6)	110 (28.2)	
No	84(64.6)	196(75.4)	280 (71.8)	
GDM				1.000
Yes	3 (2.3)	6(2.3)	9(2.3)	
No	127(97.7)	254(97.7)	381(97.7)	

Table 8b: Association between Maternal Obstetric Determinants and Preterm Delivery

Maternal exposure	Preterm (%) N=130	Term (%) N=260	Total (%) N=390	P-value
PIH				**<0.001**
Yes	64(49.2)	57 (21.9)	121 (31.0)	
No	66 (50.8)	203 (78.1)	269 (69.0)	
Pre-eclampsia/eclampsia				**<0.001**
Yes	61(46.9)	36 (13.9)	97 (24.9)	
No	69 (53.1)	224 (86.1)	293 (75.1)	
Preterm history				0.13
Yes	18(13.8)	23 (8.9)	41 (10.51)	
No	112(86.2)	237 (91.1)	349 (89.49)	
Birth Interval				0.29
<23 months	63(48.5)	111(42.69)	174(44.62)	
24-59 months	39(30.0)	99 (38.08)	138 (35.38)	
>60 months	28(21.54)	50(19.23)	78 (20.00)	
Previous mode of delivery				**0.02**
Vaginal	70(78.7)	115(65.0)	185(69.6)	
LUSCS	19(21.4)	62(35.0)	81(30.4)	
Previous Abortion				0.06
Yes	78(60.0)	130 (50.0)	208 (53.3)	
No	52 (40.0)	130 (50.0)	182 (46.7)	
Cervical manipulation				0.68
Yes	35(26.9)	65(25.0)	100(25.6)	
No	95(73.1)	195 (75.0)	290 (74.4)	
Contraceptive use				0.13
Yes	36(27.7)	54(20.8)	90(23.1)	
No	94 (72.3)	206(79.2)	300 (76.9)	
Fertility drug use				0.23**5**
Yes	6(5.3)	7(3.0)	13(3.6)	
No	102(94.4)	229(97.0)	331(92.2)	

In the univariate analysis of the maternal obstetric and gynaecologic determinants, mothers who attended antenatal clinic up to and more than four times which is the recommended times for mothers to attend ANC had odds of 0.2(95%CI 0.1-0.3) times reduced for preterm delivery compared to mothers who attended ANC less than four times. The odds of a mother who did not have APH is decreased by 0.5 (95%CI 0.2-0.9) times among mothers with preterm delivery compared to mothers who had APH. In a univariate analysis, the odds of a mother delivering multiple babies (twin/triplet) was

increased by 5.7 (2.0-16.3) times among preterm delivery compared to mothers who had singleton deliveries. Mothers who had preterm delivery were at a 1.6(1.1-2.6) times increased risk of being delivered by LUSCS compared to mothers who delivered by Spontaneous Vertex Delivery (SVD).

The odds of preterm delivery among mothers who did not have PROM was decreased by 0.6 (0.4-0.9) times the odds of mothers who had PROM

Mothers who did not have hypertensive complications in pregnancy had decreased odds of preterm delivery compared to mothers who had hypertensive complications in pregnancy (PIH cOR=0.3 (95%CI 0.2-0.5), (Severe pre-eclampsia/eclampsia cOR =0.2 95%CI 0.1-0.3). However, mothers who had had a previous LUSCS delivery were 0.5 (95%CI 0.5-0.9) times at a lower odds compared to mothers who delivered by SVD

Parity (p= 0.93), gestational diabetes (p=1.00), history of preterm delivery (p= 0.14), birth interval (p=0.29) cervical manipulation (p=0.68), abortion (p=0.06), fertility drug use (p=0.26) and contraceptive use (p=0.13) were not significantly associated with preterm delivery.

In the multivariate analysis, number of ANC visits (p=<0.001), number of babies delivered (p=0.02), PROM (p=0.02) and severe pre-eclampsia/eclampsia (p=<0.01) remained significant (Table 9a and Table 9b).

Table 9a: Adjusted Odds Ratio of Maternal Obstetric Determinants and Preterm Delivery

Maternal exposure	OR (95%CI)	*p*-value	AOR(95%CI)	*p*-value
Parity		**0.93**		
Nulliparity	1			
Primiparity	0.9(0.5-1.6)	0.75		
Multiparity	0.9(0.6-1.5)	0.73		
No. ANC visit		**<0.001**		
1-3	1			
>4	0.2(0.1-0.3)	<0.001	**0.2(0.1-0.4)**	**<0.001**
APH before		**0.05**		
Yes	1			
No	0.5(0.2-1.0)	0.05		
Babies delivered		**<0.001**		
Singleton	1			
Multiple	5.7(2.0-16.3)	<0.001	4.9(1.3-19.3)	**0.02**
Mode of delivery		**0.02**		
Vaginal	1			
LUSCS	1.6(1.1-2.6)	0.03		
(P)PROM labor		**0.03**		
Yes	1			
No	0.6(0.4-0.9)	0.03	**0.4(0.2-0.8)**	**0.02**
GDM		1.00		
Yes	1			
No	1.0(0.2-4.1)	1.00		

Thus the odds of a mother attending ANC up to and greater that 4 was 0.2(95% CI 0.1-04) times reduced for preterm delivery compared to a mother who attended ANC less than 4 times when adjusted. The odds of a mother having a preterm delivery was increased by 4.9 (95% CI 1.3-19.3) times for multiple delivery compared to singleton delivery when adjusted. The odds of a preterm delivery by a mother who had PROM is 0.4 (95%CI 0.2-0.8) times the odds of a mother who did not get a PROM when adjusted

Table 9b: Adjusted Odds Ratio of Maternal Obstetric Determinants and Preterm Delivery

Maternal exposure	OR (95%CI)	*p*-value	AOR(95%CI)	*p*-value
PIH		**<0.001**		
Yes	1			
No	0.3(0.2-0.5)	<0.001		
Pre-eclampsia/eclampsia		**<0.001**		
Yes	1			
No	0.2(0.1-0.3)	<0.001	**0.2(0.1-0.7)**	**<0.001**
Preterm history		0.14		
Yes	1			
No	0.6(0.3-1.2)	0.13		
Birth Interval		0.29		
<24 months	1			
24-59 months	0.7(0.4-1.1)	0.14		
>60 months	1.0(0.6-1.7)	0.96		
Previous mode of delivery		0.07		
Vaginal	1			
LUSCS	0.5(0.3-0.9)	0.02		
Previous Abortion		0.06		
Yes	1			
No	0.7(0.4-1.0)	0.06		
Cervical manipulation		0.68		
Yes	1			
No	0.9(0.6-1.5)	0.68		
Contraceptive use		0.13		
Yes	1			
No	0.7(0.4-1.1)	0.13		
Fertility drug use		0.25		
Yes	1			
No	0.5(0.2-1.6)	0.25		

The odds of a mother with severe pre-eclampsia/eclampsia is 0.2 (95%CI 0.1-0.7) times decreased in preterm delivery than mothers without pre-eclampsia./eclampsia when adjusted.

APH, previous mode of delivery, current mode delivery, PIH, and abortion lost its significant association when adjusted with the above variables.

4.4 Pre-existing medical Conditions in Pregnancy

In this study at the univariable analysis, chronic hypertension (p=0.004) and sickling status (p=0.05) of the mothers, were found to be significantly associated with preterm delivery. However, booking Hb, maternal HIV, HBV, VDRL status, chronic diabetes, epilepsy, mental illness and uterine surgery were not significantly associated with preterm delivery (Table 10).

Table 10: Association between Pre-existing Medical Conditions and Preterm Delivery

Maternal exposure	Preterm (%) N=130	Term (%) N=260	Total (%) N=390	P-value
Booking Hb (g/dL)				0.40
<11	52(41.9)	116(46.6)	168(45.4)	
≥11	72(58.1)	133(53.4)	205(55.0)	
Chronic HPT				**<0.001**
Yes	18(13.9)	14(5.4)	32(8.2)	
No	112(86.2)	246(94.6)	358 (91.8)	
Chronic Diabetes				0.67
Yes	3(2.3)	8 (3.1)	11(2.8)	
No	127(97.7)	252 (96.9)	379 (97.2)	
Epilepsy				0.78
Yes	2(1.5)	5 (1.9)	7(1.8)	
No	128(98.5)	254(98.1)	382(98.2)	
Mental illness				0.39
Yes	3(2.3)	3 (1.2)	6(1.6)	
No	126 (97.7)	251(98.8)	377(98.4)	
Uterine surgery				0.25
Yes	28(25.0)	76(31.0)	104(29.1)	
No	84(75.0)	169(69.0)	253(70.9)	
Maternal HIV				0.17
Not-reactive	107(99.1)	251(96.5)	358(97.3)	
Reactive	1(0.9)	9(3.5)	10(2.7)	
Maternal HBV				0.67
Not-reactive	109(94.8)	249(95.8)	358(95.5)	
Reactive	6(45.2)	11(4.2)	17(4.5)	
Maternal VDRL status				0.19
Not reactive	105(94.6)	253(97.3)	358(92.3)	
Reactive	6(5.4)	7(2.7)	13(3.5)	
Maternal G6DP status				0.21
No defect	123(96.9)	243(93.8)	366(94.8)	
Defect	4(3.2)	16(6.2)	20(5.2)	
Maternal sickling status				**0.05**
Negative	101(91.0)	201(83.4)	302(85.8)	
Positive	10(9.1)	40(16.6)	50(14.2)	

Table 11: Adjusted Ratio of Pre-existing Medical Conditions and Preterm Delivery

Maternal exposure	OR (95%CI)	p-value	AOR(95%CI)	p-value
Booking Hb (g/dL)		**0.40**		
<11	1			
≥11	1.2(0.8-1.9)	0.40		
Chronic HPT		**0.01**		
Yes	1			
No	0.4(0.2-0.7)	0.01	2.6(1.2-5.8)	**0.01**
Chronic Diabetes		**0.66**		
Yes	1			
No	1.3(0.4-5.2)	0.67		
Epilepsy		**0.78**		
Yes	1			
No	1.2(0.2-6.6)	0.78		
Mental illness		**0.41**		
Yes	1			
No	0.5(00.1-2.5)	0.40		
Uterine surgery		**0.24**		
Yes	1			
No	1.3(0.8-2.2)	0.25		
Maternal HIV		**0.13**		
Not-reactive	1			
Reactive	0.3(0.0-2.1)	0.21		
Maternal HBV		**0.68**		
Not-reactive	1			
Reactive	0.8(0.3-2.2)	0.67		
Maternal VDRL status		**0.21**		
Not reactive	1			
Reactive	21.(0.7-6.3)	0.20		
Maternal G6DP status		**0.19**		
No defect	1			
Defect	0.4(0.2-1.5)	0.22		
Maternal sickling status		**0.05**		
Negative	1			
Positive	0.5(0.2-1.0)	0.97	1.9(0.9-4.0)	0.08

In the univariable model, mothers who were normotensive prior to booking at antenatal clinic had a reduced odds of preterm delivery compared with mothers who had chronic hypertension cOR=0.4(0.2-0.7) as illustrated in Table 10. Likewise, the odds of mothers who were sickling positive were 0.5(0.2-1.0) times decreased in delivering a preterm compared with a mother who was sickling negative.

4.5 Foetal Determinants of Preterm Delivery

In this study, all the foetal factors were found to be significantly associated with preterm delivery at the univariate level of analysis including birth weight (p=<0.001), baby sex (p=0.04), foetal presentation (p=0.002), birth defect (p=0.04), Apgar score (p=<0.001), Apgar score (<0.001) as shown in Table 12.

Table 12: Foetal related determinants of Preterm Delivery (N=390)

Foetal Factors	Preterm N=130 (%)	Term N=260 (%)	Total N=390 (%)	P-value
Birth weight (kg)				**<0.001**
<2.5	111(85.4)	19(7.7)	131(33.6)	
≥2.5	19(19.2)	240(92.3)	259 (66.4)	
Baby sex				**0.04**
Male	59(45.4)	147(56.5)	206(52.8)	
Female	71(54.6)	113(43.5)	184(47.2)	
Foetal presentation				**0.02**
Cephalic	108(83.1)	237(91.2)	345(88.5)	
Breech	22(16.9)	23(8.8)	45(11.5)	
Birth defect				**0.05**
Yes	2(1.5)	0 (0.0)	2(0.5)	
No	128(98.5)	260 (100.0)	388(99.5)	
APGAR Score1				**<0.001**
<7	89(68.5)	111(42.7)	200(51.3)	
≥7	41(31.5)	149(57.3)	190(48.7)	
APGAR Score5				**<0.001**
<7	53(40.8)	32(12.3)	85(21.8)	
≥7	77(59.2)	228(87.7)	305(78.2)	

Mothers with baby birth weight greater than 2.5kg had a reduced odds of being born a preterm compared to babies with birth weight less than 2.5kg (cOR=0.0 95%CI 0.0-0.0). The odds of a mother with a female foetus was 1.6 (95% CI 1.0-2.4) times likely to be born a preterm compared to the odds of a mother with a male foetus. The odds of a baby born with breech presentation are increased by 2.1 (95%CI 1.1-3.9) times being born a preterm compared to the odds of a baby born cephalic. Similarly, the odds of a baby born with an Apgar score <7 at the 1st and 5th minute is reduced by 0.3 (95% CI 0.2-0.5) and

0.2(95%CI 0.1-0.3) times respectively being born a preterm compared to a baby born with Apgar score >7 at the 1st and 5th minute as illustrated in Table 13

Table 13: Adjusted Odds Ratio of Foetal Determinants of Preterm Delivery

Foetal Factors	OR (95%CI)	p-value	AOR(95%CI)	p-value
Birth weight (kg)		<0.001		
<2.5	1			
≥2.5	0.0(0.01-0.04)		**0.02(0.01-0.05)**	**<0.001**
Baby sex		0.04		
Male	1			
Female	1.6(1.0-2.4)	0.04	1.2(0.7-2.3)	0.52
Foetal presentation		0.02		
Cephalic	1			
Breech	2.1(1.1-3.9)	0.02	1.9(0.7-4.9)	0.19
Birth defect				
Yes	1(empty)			
No	1(omitted			
APGAR Score1		<0.001		
<7	1			
≥7	0.3(0.2-0.5)	<0.001	0.9(0.4-1.8)	0.72
APGAR Score5		<0.001		
<7	1			
≥7	0.2(0.1-0.3)	<0.001	**0.4(0.2-1.0)**	**0.05**

In the multivariate level of analysis, birth weight and Apgar score 5 remained significantly associated with preterm delivery P=<0.001) and (p=0.05) respectively.

When adjusted, the odds of a mother delivering a baby with birth weight >2.5 kg was decreased by 98% delivering a preterm baby compared to a mother who delivered a baby with a birth weight of <2.5kg. . Similarly, the odds of a baby born with Apgar score >7 was 0.02 (95% CI 0.0-0.5) times reduced for preterm delivery compared to a baby born with an Apgar score of <7.

The odds of a baby born with Apgar score >7 at the 5th minute was reduced by 0.4 (95% CI 0.2-1.0) times being born a preterm compared to a baby born with an Apgar score of <7 when adjusted with birth weight.

In the multivariate analysis, baby sex, foetal presentation and Apgar score1, lost their significant association with preterm delivery.

CHAPTER FIVE

5.0 DISCUSSION

5.1 Determinants of Preterm Delivery

Globally, the world could not achieve the millennium development goal four (MDG 4) that focused on reducing under-five mortality which target elapsed in 2015.In many countries, the under-five mortality target set could not be achieved however, they were able to attain some reduction. It was noted that the interventions to reduce under-five mortality impacted on the age category 1 month to 11 months and 1 year to 4 years. Similar to many developing countries, Ghana was not an exception in that the greatest challenge was confined to neonatal mortality. It was observed that about a third of neonatal mortality is attributable to prematurity and its complications.

Determinants of preterm delivery using secondary data from October, 2015 to May, 2016 in Ridge Regional Hospital (RRH) puts the proportion of preterm delivery at 15.3%.This proportion is high and this is because Ridge Regional Hospital happens to be the main secondary referral facility in Greater Accra Region (GAR) and provides specialist services in Emergency Obstetric and Neonatal Care (EmONC).As the main secondary referral facility in Greater Accra Region (GAR) and the other nearby regions such as Central, Eastern and Volta Regions, most of the complications associated with pregnancy, delivery and newborn care are referred to Ridge Regional Hospital. The proportion of preterm delivery in this study compares with a study done in Nigeria by Mokuolu et al., (2010) to determine the prevalence and determinants of pre-term deliveries at the University of Ilorin Teaching Hospital, Ilorin. Preterm delivery was 12% of the 2,489. Similarly, in a study done to determine the Prevalence and factors

associated with preterm birth at Kenyatta National Hospital (KNH), the proportion of preterm birth was 18.3% (Wagura, 2014). These proportions are consistent with this study as they are referral facilities in their respective countries. Again, Martin et al., (Martin et al. 2015), observed that the proportion of preterm birth declined for the seventh straight year to 11.4% in a study that looked at US birth data in 2013.In a different study Poulsen et al. (2015) observed that the proportion of singleton preterm live delivery among 12 cohorts in Europe varied between 3.7% and 7.5% (Poulsen et al., 2015).

5.2 Sociodemographic Determinants of Preterm Delivery

Extremes of maternal age confer a substantial risk of preterm delivery. In this study, age is not significantly associated with preterm delivery. About 76% of all the mothers are within the expected age bracket with a similar proportion of preterm to term. This is observed because the clients referred from other facilities had other reasons for the referral which could happen to both preterm or term mothers. This is contrary to many other studies that showed a significant association between age and preterm delivery. Advancing maternal age as is observed to be significantly associated with preterm delivery was not consistent with this study (Xiong et al., 2015). Also in a study to determine the association between maternal childbearing age perinatal outcomes, Sujan et al., (2015observed an association between maternal age at childbearing and preterm delivery(Sujan et al., 2015).

In this study maternal height did not show any significant association with preterm delivery. This is probably so because the perception of short stature mother's vulnerability has been challenged in recent studies. Other obscure factors may have

influenced the occurrence of preterm in this group of women. This is similar to finding by Sebayang et al., (2012), where they reviewed the association between preterm delivery and the risk factors in Lombok, Indonesia and height was not significantly associated with preterm delivery. Contrary to this study, Rao et al., conducted a research to identify the risk factors for preterm deliveries in a secondary care hospital, southern India, height <150cm was found to be significantly associated to with preterm delivery. (Rao et al., 2014) They noted that the commonest non- obstetrical risk factor was height <1.50 m.

-In this study, Body Mass Index (BMI) was not significantly associated with preterm delivery. This was supported by a study done by Palatnik et al. (2016). They also noticed conflicting evidence about the association of maternal weight with spontaneous preterm delivery. With all the adverse outcomes associated with high BMI and pregnancy, women with high BMI category had reduced risk of preterm birth(Palatnik et al., 2016). However, in a study to determine Body Mass Index change between pregnancies and risk of spontaneous preterm birth, Riley et al. (2016) noted that among multiparous women, obesity was associated with reduced risk of spontaneous preterm delivery (Riley et al., 2016).

Maternal educational level, which is generally accepted as a reliable indicator of the socio-economic status of the family, might at least partially account for variation in gestational age, because of the differences in availability of antenatal care.

Maternal educational level did not show a significant association with preterm delivery in this study. However, it is noted that increasing educational background of the mother such as tertiary education has a 40% higher risk of delivering preterm compared to no or lower education. This may be because mothers with higher education have also advanced

in age and thus may be desperate for a baby. Thus with a precious baby, the slightest suspicion of complication may cause an obstetrician to empty the uterus. Also most of these women with higher education happen to be nulliparous who have access to information and could readily contact their providers sometimes alarming them to take an iatrogenic decision and supports the early emptying of uterus by whatever means. These findings contrast with a study that explored educational disparities as a risk of preterm delivery. This was a comparative study of 12 European birth cohorts where Poulsen et al.(2015) observed varied association between educational background and preterm delivery. They noted that 8 out of 12 cohorts with low educational level favored preterm delivery. This current study conflicts (P. Astolfi & Zonta, 1999) on the risk of preterm delivery with respect to maternal education, as expected, among the less educated mothers a significantly higher quota of preterm deliveries occurred.

Similar to other studies above that higher educational background protects against pretem delivery and contrasting this current study, Morgen et al.(2008) observed in a Danish National Birth Cohort study that the risk of preterm delivery was higher in mothers with <10 years of education compared with mothers with >12 years of education. (Morgen et al., 2008). In the Ghanaian context, >12 years of education implies tertiary level of education.

This study did not show any significant association between occupation, employment status and preterm delivery. This is probably so because generally, the calibre of clients who are referred to the study hospital have a similar lower socioeconomic status. In early preterm (<32 weeks' gestation) new-borns, the impact of lifestyle factors on this group is well documented whereas in late and moderate preterm (LMPT) births (32–36 weeks of

gestation) representing 75% of all preterm births, it is poorly understood (Moser et al., 2007). Research has highlighted wide socio-economic inequalities in the rates of preterm birth (L. K. Smith et al., 2009), (March of dimes, 2013) though the precise mechanistic links for these inequalities are unknown

In this study, none of the participants smokes cigarette or has ever smoked cigarette or drunk excessive alcohol .This is so because socio-culturally in Ghana, it is unacceptable for women to be smoking cigarette. It is also considered immoral for a woman to smoke and drink alcohol excessively more so during pregnancy. Thus even if they did, they would not disclose it knowing the enormous complications associated with smoking cigarette and consuming alcohol being reverse causation.

In contrast to other studies, many lifestyle factors are closely linked to material and financial deprivation, and their detrimental effects on preterm birth have been reported. Key risk factors associated with preterm birth include smoking (Miyake et al., 2013) and excessive alcohol intake during pregnancy (Cornman-homonoff et al., (2012). In a study conducted in singleton live births to women residing in Leicestershire and Nottinghamshire, UK, a culture that does not frown on smoking and alcohol consumption however, they observed no significant effect of alcohol or recreational drug use on preterm delivery. However, there was a significant association between smoking cigarette and preterm delivery and then suggested that stopping smoking in early pregnancy lowered the risk thus an effective strategy to reduce preterm delivery. (Smith et al., 2015)

In this current study, partner support is significantly associated with preterm delivery Thus mothers who receive support from their partners have a lower odds of preterm delivery. It is observed that getting the needed support from a partner, provided the

ambient environment for the mother to be reminded and encouraged to attend antenatal care clinic. Likewise, partner support in the form of giving the woman money for transport and home-keeping all protect against preterm delivery. This compares well with another study where mothers with no family and partner support associated with low income had higher Odds (AOR=2.6, 95%CI: 1.1-6.6) of delivering preterm (Abdela Amanon, 2015).

In this study, residence did not show any significant association. This is probably so because, Accra and its environs have all become urbanised and so the rural-urban classification did not hold. This finding contrasts with the work done by Sebayang et al.(2012) where they noted socioeconomic indicators such as mother's educational background, either rural or urban residence and household wealth were also associated with to preterm births (Sebayang et al., 2012)..

5.3 Maternal Obstetric Determinants of Preterm Delivery

Hypertensive complications in pregnancy including pregnancy-induced hypertension (PIH), Pre-eclampsia and Eclampsia; Antepartum haemorrhage (APH) and Preterm Premature Rapture of Membrane (PPROM) are generally known to be obstetric factors found to be associated with preterm delivery.

In the current study, pregnancy induced hypertension and it complications are contributing determinants of preterm delivery. A mother with hypertensive complication in pregnancy is at least 3.5 times at risk of preterm delivery compared to a mother who is free of hypertensive complications in pregnancy. This is so because, elevated blood pressure in pregnancy in itself is detrimental to the health of the mother and foetus. Even

though the blood pressure is high, it compromises perfusion to the foetus and has a medical risk of cardiovascular complications for the mother. More so if it is complicated with urine protein and elevated uric acid level, it tips the mother into imminent eclampsia and if nothing is done about it eclampsia ensues which is life-threatening for the mother and ultimately for the foetus too. Since the cause of this cannot be predicted and also its management is difficult, with a concomitant high mortality, providers are extremely careful in managing mothers with hypertensive complications in pregnancy. Most of the time, when the blood pressure become uncontrollable and/or the unfortunate incident of eclampsia occurs, the quickest means of emptying the uterus become the choice the mainstay management. Thus the intervention before term account for preterm delivery

In the current study, the results are similar to that observed in Ethiopia where mothers who had PIH and APH were 2.9 times more likely to develop preterm birth than mothers without any of the above exposures (Abdela Amanon, 2015).

In this study, APH is significantly associated with preterm delivery. The odds is twice as much as a mother with APH delivering a preterm compared to a mother who did not have APH Commonly the underlying causes of APH include localised vaginal bleeding and bleeding from the uterus. For localised vaginal bleeding it could be as a result of trauma, spontaneous bleeding and bleeding varices. Bleeding from the uterus include placentae Previa and placentae abruptio. Since bleeding from the vagina in a pregnant woman who has reached viability (>28 weeks) requires less exploration in the vagina, a quick assessment of the mother and foetus may favour a quick emptying of the uterus. Thus once a pregnant women who has reached viability (>28 weeks) and presents with bleeding from the vagina, the provider is careful not to lose either or both of the mother

and baby. By and large these obstetric indications favour a quick delivery and ultimately preterm delivery. This is similar to a study in Nigeria where APH was observed to be positively associated with preterm delivery (O. A. Mokuolu et al., 2010)

In this study, findings are consistent with preterm delivery when a mother is exposed to Preterm Premature Rapture of Membrane (PROM). This is obvious because anytime the membrane ruptures and the mother loses liquor, two complications are at stake. These include oligohydramnios/anhydramnois with an ultimate complication of foetal distress or stillbirth. The other complication is chorioamnionitis which has far reaching complications for the mother that can lead to sepsis and ultimately mortality. Thus, in order to prevent the complications discussed, providers usually intervene either induce them to have a vaginal delivery if the cervix is favourable or abdominally if otherwise whichever is the quickest way to save the mother and/or baby. This is similar to a study conducted to determine the Prevalence and factors associated with preterm birth at Kenyatta National Hospital (KNH). (Wagura, 2014). The same can be said of APH, and PPROM which were independently and collectively in different studies which were positively associated with prematurity with an odds ratio at least 4.8. (Mokuolu et al., 2010), (Abdela Amanon, 2015). Prevention of PPROM and spontaneous preterm birth (PTB) may benefit from greater attention to hypertensive complications (preeclampsia and eclampsia), anaemia and other comorbidities localized to the reproductive system.

Multiple gestation is a grave contributor and well-established fact determining preterm delivery. In this study, multiple gestations are positively associated with preterm delivery. This is expected because multiple gestations are typically associated with complications. In the study, all the 3 multiple gestations including 2 twins and 1 triplet are all preterm

deliveries. All three were delivered by caesarean section. The two had hypertensive complication and the triplet had a PPROM. This compares with a study to determine the prevalence and factors associated with preterm delivery in KNH, Kenya (Wagura, 2014) and that in Ethiopia (Abdela Amanon, 2015).

Commonly, maternal educational level, an accepted and a reliable indicator of the socio-economic status plays a role in variation in gestational age, because of the differences in availability and accessibility of antenatal care. In this study, the number of times a mother attends ANC is significantly associated with preterm delivery. Mothers who make ≥4 visits to the ANC are protected from preterm delivery compared to those who attended ANC <4 visits. Similarly, (Abdela Amanon, 2015) noted in Ethiopia that mothers who attended ANC and follow-up visit during the index pregnancy, these visits were negatively associated (75% decreased risk) with preterm birth compared to those who did not. Also mothers who had not booked ANC are at a higher risk of preterm labour and delivery (P=0.000; OR=4.67; 95%CI=3.33–6.56)(O. A. Mokuolu et al., 2010).

It is established in many studies that among the reasons for iatrogenic preterm delivery are maternal conditions, such as preeclampsia, and foetal distress. However, in the past decade, the number of preterm cesarean sections performed, regardless of gestational age, has increased by 33 to 50%, (Office for National Statistics (2014)) without a similar change in maternal risk profiles. (Tindall, 2011). In this study, the results show that LUSCS has an increased odds of preterm delivery compared to spontaneous delivery(Mokuolu et al., 2010) also observed in another study that cesarean delivery was associated with preterm delivery. LUSCS was strongly associated with nulliparous

mothers compared to multiparous mothers who had spontaneous preterm delivery (Smith et al., 2007).

Parity was not significantly associated with preterm delivery in this study. This is probably so because nearly all the mothers who delivered were referred and have similar parity across term and preterm. Even though the parity is not significantly associated with preterm delivery in this study, the odds of a multiparous woman delivering a preterm compared to a nulliparous woman is about 2 times. Typically, in an aged nulliparous woman who has been managing infertility, chances are that with the slightest obstetric complication compromising the life of the foetus, providers do not hesitate to empty the uterus.

These findings are similar to and supported by Losonkova et al (2010) and Wagura (2014) They observed that advancing maternal age (women>40 years) were at a higher risk of preterm delivery and even higher if they were nulliparous compared to younger women who were multiparous (Lisonkova et. al, 2010). Similarly, a study done to determine the factors associated with preterm birth at Kenyatta national hospital (KNH), the multiparty ≥ 4 was associated with preterm delivery(Wagura, 2014). However, this contrasted with findings from a study done in Yasuj, Iran in 2010, the preterm labour risk in women with two or more pregnancies was 5.5 times more than women with less than two pregnancies (Nabavizadeh et al., 2012). Also in a systematic review and meta-analysis to look at parity and preterm delivery, Shah (2010) (Shah & Knowledge Synthesis Group on Determinants of LBW/PT births, 2010) observed that nulliparity was negatively associated with preterm delivery.

In general, most patients with a previous spontaneous preterm birth will deliver at term in a subsequent pregnancy. In this study, a history of preterm delivery is not significantly associated with preterm delivery. Even so the odds of a woman without previous preterm delivery are 1.7 times increased for a current preterm delivery compared to a woman with a previous preterm delivery. This findings probably occurred because; Ridge Regional Hospital (RRH) receives referrals from all primary care facilities in and around Accra and the reasons for referring cut across for both term and preterm. Thus the reason for referral for a mother who delivered a preterm could have been the same reason for which a mother is referred for term. The indication for the previous and the current preterm delivery is also important. Most especially if there is a predisposing obstetric indication for the previous preterm delivery and the mother did not experience the same or different obstetric indication, then current preterm delivery is not expected. By and large, if the previous preterm delivery was spontaneous, then there is a higher odds of a current preterm delivery. However in this study, an increased proportion of the preterm delivery is delivered by caesarean section. This is supported by a study by Mazaki-Tovi et al (2007) where they noticed that previous preterm delivery and in fact recurrent preterm delivery is strongly associated with a current preterm delivery especially if it was spontaneous labour (with intact or ruptured membranes). (Mazaki-Tovi et al., 2007). This study findings contrasts with a study done to determine the prevalence and factors associated with preterm birth at Kenyatta national hospital (KNH), where previous preterm birth was strongly associated with preterm delivery (Wagura, 2014). Worst of it, the earlier the gestational age of the preterm birth, the higher the likelihood of recurrence. Therefore counselling is advised even prior to conception to prepare the couple

psychologically and efforts are be made to identify potentially treatable causes even though the attributable risk of these conditions for preterm birth is extremely low and in this study is insignificant.

5.4 Pre-existing Medical Conditions in Pregnancy

The commonest obstetrical risk factor for preterm birth is hypertensive disorders of pregnancy. In this study, chronic hypertension in a mother is positively associated with preterm delivery. Pre-existing (chronic) hypertension is a condition which when unmanaged has enormous complications such as renal disease, visual problems, and cardiovascular complications including cerebrovascular accident (stroke) even outside of pregnancy. Pregnancy though not a disease in itself is a stressful situation for a woman so when a pregnant woman who was previously hypertensive is not managed, the usual complications of hypertension are inevitable. More so they can also develop a superimposed hypertension with its complications in pregnancy. It is well established that when the blood pressure cannot be controlled in pregnancy, it becomes an indication to empty the uterus by whatever means. In this study, a greater proportion of mothers who are chronically hypertensive or even developed pregnancy-induced hypertension and/or its complications are either induced to deliver spontaneously or by caesarean section. This accounts for the increased odds of hypertension-related preterm delivery.

Many studies support this study findings where the authors observed that chronic hypertension was positively associated with preterm delivery in Southern India (Rao et al., 2014);. Ethiopia, (Abdela Amanon, 2015).

Closely followed after hypertension and also sometimes concurrent is diabetes in pregnancy. In this study chronic diabetes, gestational diabetes and its complications is not significantly associated with preterm delivery. Probably this occurred because of issues with sample size. In all only 9 out of 390 had gestational diabetes and 11 out of 390 had chronic diabetes. The proportions among preterm and term is approximately the same. This current study agrees with findings from Kock et al., (2010) where their results of significant association between chronic hypertension and preterm delivery. However it contrasted the association between maternal chronic diabetes and preterm delivery reported by Kock et al.(Köck et al., 2010). They concluded that Diabestes Mellitus (DM) significantly affects the gestational age and the incidence of spontaneous preterm delivery. In contrast to this study, another study in Yasuj, Iran, showed that history of diabetes was found to be a risk factor for preterm delivery (Nabavizadeh et al., 2012).

In this study, sickling status of the mother is not significantly associated with preterm delivery. However, the odds of a mother being sickling positive is decreased by 50% compared to sickling negative mothers. In Ridge Regional Hospital (RRH) and typically in many other hospitals in Ghana, haemoglobin genotype among pregnant women is tested only when the sickling test is positive. This is one of the ways of classifying a pregnancy as high risk if the sickling status is positive. However, it is known that in some instances the sickling negative could actually be AC or CC instead of the expected AA. Since the haemoglobin genotype for all the sickling positive was AS, which is just the possession of the trait, this may be the reason for the results. This agrees with a study that assessed whether sickle cell trait had adverse pregnancy outcome. Their finding showed no significant association between mother having a sickle cell trait (HbAS) and

adverse pregnancy outcomes both for mother and baby. This is similar to a study of SCD cohort, no significant differences were found according to infant hemoglobin phenotype (Brown et al., 1994). Other studies found associations contrasting this current study as relates to foetal anomalies and low birth weight (Kuo & Caughey, 2016), (Andra H. James, 2014) and (Thame et al., 2016) all found complicated pregnancy outcomes with sickle cell disease.

This study did not show any significant association between low Haemoglobin (Hb) and preterm delivery. Even though about half of the study participants had Hb below 11g/dL at booking, the proportions between term and preterm were similar. All measurements done during antenatal care cannot be guaranteed 100% because these were secondary data that was reviewed from the antenatal care book. Perhaps severe anaemia (Hb<7) could have shown a difference. As it is, referrals to Ridge Regional Hospital (RRH) contributes about 85% of all deliveries and these come with some complication, thus term or preterm, it is associated with some maternal or foetal indication. Anaemia contributes over 50% of the deliveries of which term and preterm had equal proportions. In contrast to these findings, many other studies showed significant association with low Hb favouring preterm delivery (Abdela Amanon, 2015) (Rahman et al., 2016) (Broek, Jean-Baptiste, & Neilson, 2014) (Zerfu, Umeta, & Baye, 2016). Also in this study, the results did not show any significant association between BMI (height and weight) and preterm delivery. As Ridge Regional Hospital (RRH) remains the main secondary referral facility in Greater Accra Region, equal proportions of preterm and term mothers are referred to deliver here. In general many studies have found a significant association between BMI (height and weight) preterm delivery with some studies showing undernutrition favouring

preterm with others overweight and obesity positively associated with preterm delivery (Sven Cnattingius, 2013), (Wang et al., 2011), (Han et al., 2011).

In this study, epilepsy and mental illness are not significantly associated with preterm delivery. Culturally, there still remains a great deal of stigma associated with persons with epilepsy and mental illness. In fact, only 7 out of 390 (2 (1.5%) cases and 5(1.9%)controls) and 6 (3 (2.3%) cases and 3 (1.2%) controls) out of 390 reported having epilepsy or ever being diagnosed to have a seizure disorder and any kind of mental illness (depression) respectively which had similar proportions spread between term and preterm delivery. One limitation here could be reverse causation. Since there is no objective way of detecting this except for reviewing the antenatal care book or by interviewing the mother. She may not tell the truth as they may feel discriminated against if they said they had any of epilepsy or mental illness. This is in contrast with other studies where maternal epilepsy is found to have a strong association with preterm birth probably due to antiepileptic medications. Crump et al., in their study suggested that preterm birth, including late preterm birth, is strongly associated with epilepsy in Swedish adults aged 25–37 years (Crump et al., 2011).

5.6 Foetal factors Influencing Preterm Delivery

In this study, birth weight is significantly associated with preterm delivery with an odds of >50.4 times. This is expected since low birth weight <2.5kg) is typically associated with premature babies. During the third trimester that the foetus grows actively in size until term, it does not get that opportunity to attain the normal birth weight if it is born at an earlier gestation. This is similar to other studies that looked at the disparities in preterm birth and birth weight in Hong Kong (Leung, Leung, & Schooling, 2016b).and

(Davies et al., 2015) found significant association between birth weight and preterm delivery in UK.

The gender of the unborn baby also seems to play a role in the process of being born prematurely. In this study, females are 50% more likely to be born as preterm than males. In Accra and possibly Ghana, the female to male ratio is 0.52 to 0.48 respectively. Thus many more females being born preterm likely explain this results. This is in contrast to many studies where it was observed that male gender was rather positively associated with preterm delivery as was noted in a systematic review and meta-analysis of non-Asian population (Jaskolka et al., 2016), (Challis, Newnham, Petraglia, Yeganegi, & Bocking, 2013b), (Peelen et al., 2016) (Schildberger & Leitner, 2016) They also observed that male babies were at a higher risk of being born preterm with associated morbidity and mortality which contrasts with this study findings.

In this study also, birth defect is strongly associated with preterm delivery. The two birth defects recorded were tallipes and extra digits and these were preterms. In many instances, whenever there is foetal malformation, it may end up in an abortion or preterm delivery. Also some of these birth defects runs in families as occur with extra digits. This is consistent with this study as is also observed in a study conducted in University of Nigeria Teaching Hospital, Enugu, South East Nigeria where poor foetal growth was strongly associated with preterm delivery (Iyoke et al., 2014). Even so, in other studies, there were more complicated birth defects such as those involved with neurodevelopmental defects (Schieve et al., 2016).

Apgar score at 1st and 5th minutes in this study are significantly associated with preterm delivery. When adjusted, the 5th minute Apgar score remained significantly associated

with preterm delivery. This current study corroborates with a study in South East Nigeria, which determined the prevalence and perinatal mortality associated with preterm births in a tertiary medical center in where they noted a significant association between preterm delivery and Apgar Score(Iyoke et al., 2014). Also in a population-based cohort study where all babies born between 1986 and 1995 using the medical birth registry of Norway was conducted Lie et al.(2010), noted a significant association between Apgar score and preterm delivery. In all these studies, Apgar score <7 was positively associated with preterm delivery contrary to this study. In a similar study in Korle bu Teaching Hospital (KBTH) noted that in categorizing the Apgar score into <7 and >7, there was no significant difference with preterm delivery. They concluded that in the absence of any significant differences in low Apgar scores lends support to the findings in another study that antenatal maternal history and pregnancy complications (such as pre-eclampsia and vaginal bleeding) and events in labour like the use of oxytocin, magnesium and narcotics are not clearly associated with low Apgar scores (Nkyekyer et al., 2006).

5.7 Limitations of the study

Limitations of the study included.

1. Bias

Differential recall bias from mothers especially from controls compared to cases. Cases are more likely to remember incidents preceding delivery compared to controls that had a normal uneventful delivery

Duration recall especially those who had delivered before the study started. Typically, mothers who delivered in the past may not recall all the incidents preceding delivery compared to mothers who delivered during the time of the study.

Reverse causation especially in situation where it is obvious that the exposure may be responsible for the outcome especially as related to style factors. For example none of the mother smoked cigarette. Mothers are likely not to disclose certain lifestyle factors especially if it is known to be associated with preterm delivery.

2. Misclassification of the gestational age especially 'late preterm and term" as well as 'early preterm and abortion may result in underestimating or overestimating cases and controls

3. Documentation in the various registers and the ANC books may limit this study as the calibre of staff could not cannot be guaranteed and the accuracy of instrument used to estimate parameters such as blood pressure apparatus for measuring blood pressure of mother, weighing scale for measuring weight of mother and baby,

urine test strips for checking urine protein and urine sugar during antenatal care (ANC) visit.

CHAPTER SIX

6.0 CONCLUSION AND RECOMMENDATIONS

6.1 Conclusion

The proportion of preterm delivery is high - 15.3%. Mothers who receive support from their partners and who attend ANC ≥4times being the recommended number of antenatal visits from the Ministry of Health, Ghana are protected against present preterm delivery. The outcome of delivery characteristics including a baby born with male sex, cephalic presentation and Apgar score >7in the 1st and 5th minutes protect against present preterm delivery. However, chronic hypertension and hypertensive complications in pregnancy, antepartum haemorrhage (APH) preterm premature rupture of membrane (PPROM), Caesarean section delivery and being sickling negative are determinants of preterm birth. Thus the policies on partner support and at least the four visit to antenatal care clinic has proven to be protective in this study.

6.2 Recommendation

National/Regional Health Directorate Ghana Health Service Directorate are

To develop and strengthen a policy on contraceptive use, increased empowerment of women - especially adolescents (socioeconomic status) - and improved quality of care before (screening and early identification of pre-existing medical conditions in pregnancy) and at least the visit to antenatal care clinic.

Metro Health Directorate is:

To embark on intensified continuous public education on the importance of partner support in reducing preterm delivery.

Ridge Hospital

The Metro Health Directorate in conjunction with the public health unit of the hospital should embark on deliberate public health education, screening and early identification among women of the reproductive age at churches, mosques and marketplaces to institute management protocols to control chronic hypertension before they become pregnant.

Further Research

Finding the aetiology and preventable measures of pregnancy induced hypertension and its complications (PIH), premature rupture of membrane (PROM) and antepartum haemorrhage (APH) (Placenta previa, abruptio placentae)

The provision of incentives such as checking of blood pressure, height and weight (calculation of body mass index) to partners who accompany their spouses to antenatal care clinic

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APPENDIX A

Consent Form – Participants

Study Title: Determinants of Preterm Delivery in Ridge Regional Hospital, Greater Accra Region

Principal Investigator: Dr. Ernest Konadu Asiedu

Qualification: MPhil Applied Epidemiology and Disease Control

Address: School of Public Heath, University of Ghana, Legon

Greetings, my name is ……..and I am conducting this interview on behalf of Dr. Ernest Konadu Asiedu, a Master of Philosophy Applied Epidemiology and Disease Control resident, School of Public Health, University of Ghana.

Preterm labour is when a pregnant woman's body starts getting ready for birth too early in her pregnancy (before 37 weeks of pregnancy). If a baby is born early - also called 'premature' or 'preterm' – he/she may need special care. Preterm birth is the number one cause of death during the first month of life contributing about 30 - 40%, second only to infection contributing 20-30% infant and under-five mortality (Liu et al., 2015). Babies who make it often face a lifetime of medical setbacks. (Blencowe et al., 2013; Global Moms Challenge, 2012).

In both developed and developing countries, many preterm births remain unexplained. Although some studies have been done in the developed world, limited studies have been done in the Ghanaian context.

Thus the study seeks to provide evidence-based information on proportion of preterm delivery and the determinants of preterm delivery in Ridge Regional Hospital, Greater Accra Region in relation to maternal socio-demographic, maternal obstetric , maternal pre-existing pre-pregnancy medical condition (before pregnancy), and foetal determinants. It will add knowledge to the already existing published literature on determinants of preterm delivery. Finally it will help to develop new strategies in reducing preterm delivery as a national policy by Ministry of Health for implementation and ultimately reducing neonatal morbidity and mortality burden.

You are being invited to participate in the study because I understand you know the importance of your health, especially during pregnancy and you also delivered your last pregnancy here.

I would like to request you to be part of my study. If you agree to participate in this study, I would ask you a few questions centered on your last pregnancy and childbirth. This will take about 30 minutes of your time.

I would like to look into your maternal health record book you used in this last pregnancy to record what was documented. However, if you do not have one, I would like to ask you some questions concerning your last pregnancy to enable me get the information.

If you agree to participate, you be among 340 mothers who will also be participating in the study in this hospital among others in the Ho Municipality.

Participating in this study is entirely voluntary. You have the right to refuse to participate and this will not affect your rights in any way, especially to your healthcare. You are also

at liberty to withdraw from this study at any stage of your participation. I would like to see you participate to the end.

There are no direct benefits or risks in participating. You will not be paid or compensated for your participation. However, the info that the study will come out with, will help us to understand the factors and circumstances association with the increased prematurity in Ridge Regional Hospital and the entire Greater Accra Region. The questions are not very sensitive. However, whenever you feel uncomfortable answering some of them, you may choose not to answer them.

All the info collected from you will be treated strictly confidential and will be used for the intended purpose only. You will not be identified by name in any dissemination reports or publications resulting from this study.

The Ghana Health Service Ethics Review Committee has reviewed and given approval for this study to be conducted.

Do you have any questions for clarifications?

If you have any further questions regarding this study, which I could not satisfy you with the appropriate answer, you may contact:

Dr. Ernest Konadu Asiedu, (Principal Investigator) at KMC wards, postnatal ward or the Child Welfare Clinic, Ridge Regional Hospital, Accra on: Tel. 0244461895/0208287015 or e-mail:ernestkasiedu@yahoo.com

Prof. Col. Edwin A. Afari (Rtd), (Supervisor) Ghana Field Epidemiology and Laboratory Training Programme (GFELTP) School of Public Health on Tel 0208131828 or e-mail: afariea@yahoo.co.uk

Hannah Frimpong, Ghana Health Service Ethical review Committee on Tel 0507041223 or ghserc@gmail.com

Participant Consent

I have been adequately informed about the purpose, procedure, potential risks and benefits of this study. I have had the opportunity to ask questions and have been provided answers to my satisfaction. I know that I can refuse to participate in this study without any loss of benefit for which I would be entitled. I understand that even if I agree or as I have agreed, I can withdraw my consent at any time without losing any benefits or services to which I am entitled. I also understand that the information collected will be treated confidentially and will be used only for the purpose informed. Finally findings/results may assist us in policy development as regards Preterm birth.

I freely agree to participate in this study.

Right thumbprint

ID of participant……..

Signature ……...

Date……

Telephone ……..

If participant cannot read the form themselves, a witness must sign here:

WITNESS

I was present while the benefits, risks and procedures were read to and /or interpreted to the understanding of the volunteer. All questions will be answered and the volunteer will agree to take part in the research. She will also voluntarily release her maternal health book to research assistants for records abstraction

Date……

Signature……

I certify that the nature and purpose, the potential benefits, and possible risks associated with participating in this research have been explained to the above individual.

……..……

Signature of research assistant

……

Date

Appendix B

Questionnaire

Study Title: Determinants of Preterm Delivery in Ridge Regional Hospital

Record ID
Interviewer ID
Date of completion of form

The Questions below are in four (4) sections: These are Maternal Socio-demographic, Maternal Obstetric, Pre-existing maternal and Foetal determinants.

Please record the data as per questions in the space provided under various sections.

1 Date of delivery

2 Gestational Age using LMP or USG done <28 weeks

3 **What is the outcome of Delivery?** **a. Term** **b. Preterm**

4 What was the diagnosis?

A. MATERNAL SOCIO-DEMOGRAPHIC FACTORS

5 What was your age (in completed years) at delivery?

6 What was your height (cm) as recorded in the ANC book?

7 What was mother's weight (kg) 1. At registration or booking?

8 What is the marital Status of mother?

1. Married 2. Single 3. Not married 4. Divorced 5. Widowed

9 Did mother receive any social support during pregnancy such as helping with home chores, money to attend ANC, personal stuff etc (Tick all that apply)?

1. Partner/Husband support 1. yes 2. no
2. Other Family support 1. yes 2. no

10 Where do you live?

11 What is the mother's ethnicity?

1. Ga/Dangbme 2. Ewe 3. Akan 4. Other ……..

12 What is your religious denomination?

1. Christian 2. Moslem 3. Traditional 4. Other……

13 What is mother's highest educational level?

1. No formal education 2. Primary 3. Secondary 4. Tertiary

14 What is your occupation?

15 What is your employment Status? 1. Employed 2. Unemployed

DETERMINANTS OF PRETERM DELIVERY IN RIDGE REGIONAL HOSPITAL, GREATER ACCRA REGION

B. MATERNAL OBSTETRIC FACTORS

a. Present or Current Obstetric history

16 What was your parity prior to this delivery?
17 What was mother's Systolic Blood pressure?
1. At registration or booking? Urine protein
18 What was mother's Diastolic Blood Pressure
1. At registration or booking Urine glucose
19 What was mother's HIV status? 1. Reactive 2. Non-reactive
20 What was mother's HBV status? 1. Reactive 2. Non-reactive
21 What was mother's VDRL Status? 1. Reactive 2. Non-reactive
22 What was the HB at registration?
23 Did you attend ANC during this pregnancy? 1. yes 2. No
24 Did you take Folic acid during this pregnancy? 1. Yes 2. No
25 Did you take iron supplements during this pregnancy? 1. Yes 2. No
26 Did you take Anti-malaria (SP) during this pregnancy? 1. Yes 2. No
27 If Yes,(Tick the highest IPT taken) IPT 1 2 3 4 5
28 Any bleeding per vaginam before onset of labour (APH)? 1. Yes 2. No
29 Were you referred to Ridge Regional Hospital? 1. Yes 2. No
30 If yes, what was the reason?
31 Where were you referred from?
32 How many babies were delivered? 1. 1 2. 2 3. 3 4. > 4
33 Did you get Urinary tract infection? 1. Yes 2. No
34 Did you get Malaria in this pregnancy? 1. Yes 2. No
35 What was the mode of this delivery? 1. Spontaneous Vaginal Delivery
2. Assisted Vaginal Delivery 3. Elective LUSCS?
4. Emergency LUSCS?
36 If AVD/LUSCS, what was the indication?
37 What was the type of labour? 1. Spontaneous 2. Induced
3. Augmented
38 If induced/Augmented, what was the indication?
39 Did you get (Pre)term Premature Rapture of Membrane [(P)PROM] preceding onset of labour?
1. Yes 2. No
40 Did you get Gestational Diabetes (GDM)? 1. Yes 2. No
41 Did you get Pregnancy Induced Hypertension (PIH)? 1. Yes 2. No
42 Did you get severe pre-eclampsia or eclampsia? 1. Yes 2. No

b. Past obstetric history

43 Do you have a history of previous preterm delivery? 1. Yes b. No
44 What is the birth interval between the previous delivery and the current delivery (months)
45 What was the mode of previous delivery? 1. Spontaneous Vertex Delivery
2. Assisted Vaginal Delivery 3.Elective LUSCS 4.Emergency LUSCS

46 If AVD/LUSCS, what was the indication?

47 What was the type of labour? 1. Spontaneous 2. Induced 3. Augmented

48 If induced/Augmented, what was the indication?

49 Did you get Gestational Diabetes (GDM)? 1. Yes 2. No

50 Did you get Pregnancy Induced Hypertension (PIH)? 1. Yes 2. No

51 Did you get severe pre-eclampsia or eclampsia? 1. Yes 2. No

52 Have you had an abortion before? 1. Yes 2. No

53 Was EOU/ERPC/Cervical manipulation done? 1. Yes 2. No

54 Have you used contraceptives before? 1. Yes 2. No

55 Did you use fertility drugs to become pregnant? 1. Yes 2. No

D. PRE-EXISTING MEDICAL CONDITIONS IN THE MOTHER

56 Do you have a history of hypertension? 1. yes 2. No

57 Do you havea history of Heart disease? 1. yes 2. No

58 Do you have a history of Sickle Cell Disease? 1. yes 2. No

59 Do you have a history of diabetes? 1. yes 2. No

60 Do you have a history of Jaundice? 1. yes 2. No

61 Do you have a history of Respiratory diease?(TB, 1. yes 2. No

62 Do you have a history of Epilepsy? 1. yes 2. No

63 Do you have a history of Mental illness? 1. yes 2. No

64 If yes, what was the diagnosis?

65 Any previous uterine surgery? 1. yes 2. No

66 If yes, what was the diagnosis?

E. FOETAL DETERMINANTS

		1	2	3
67	Number of babies delivered			
68	What was the baby/ies birth weight(kg)?			
69	What is/are the sex(es) of baby/ies?	1. Male 2. Female	1. Male 2. Female	1. Male 2. Female
70	Foetal presentation	1. Cephalic 2. Breech 3. Transverse	1. Cephalic 2. Breech 3. Transverse	1. Cephalic 2. Breech 3. Transerse
71	APGAR score	1st min 5th min	1st min 5th min	1st min 5th min
72	Does baby have any birth defects/abnormalities?		1. Yes	b. No
73	If yes, what birth defects?			